# PLASTICS
## & MOLDED PRODUCTS

A periodical devoted to the manufacture and use of plastic and composition products

Vol. 5 FEBRUARY, 1929 No. 2


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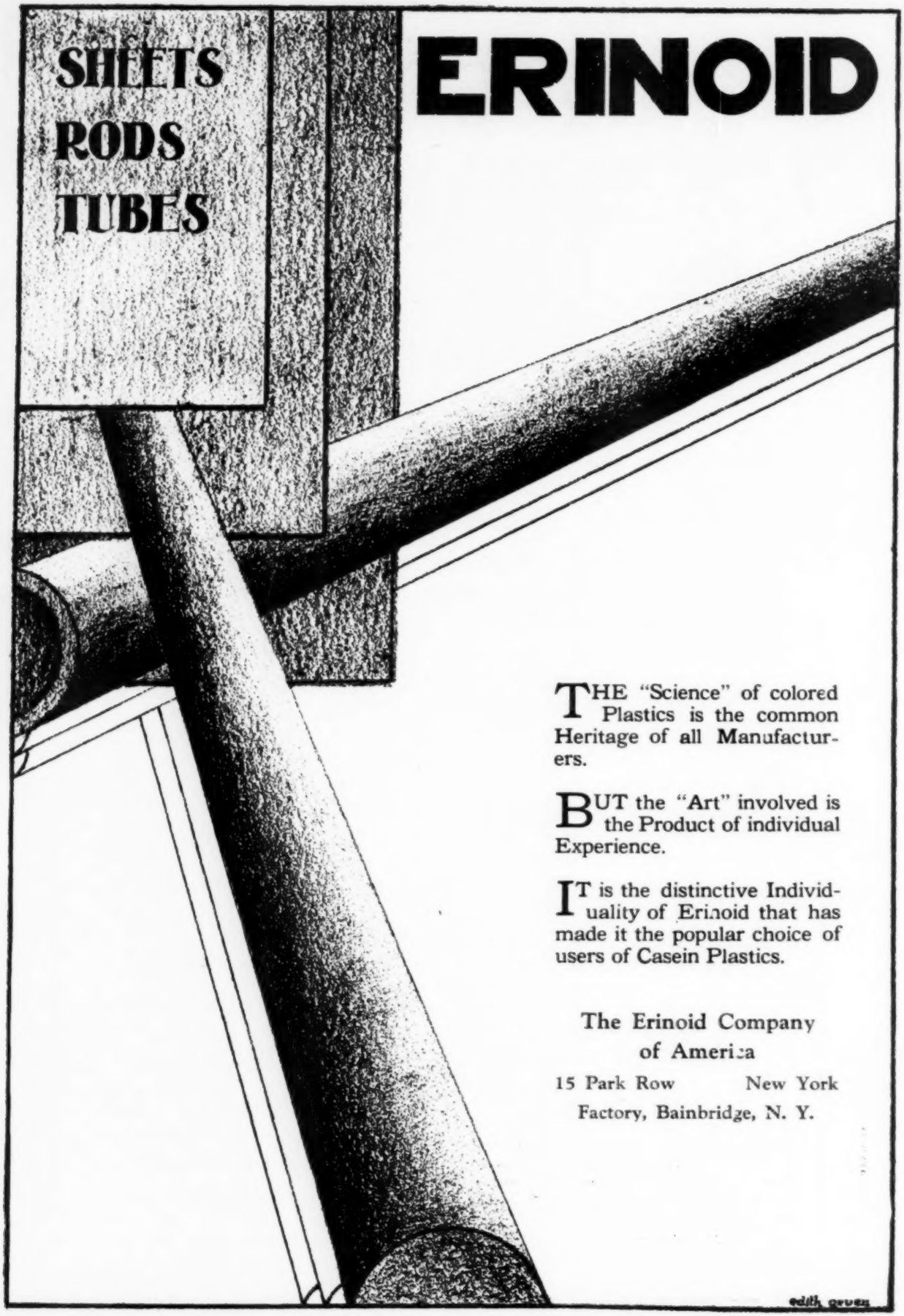
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# PLASTICS

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# Pyroxylin as an Imitative Material

## A complete review of the United States Patents relating to the use of pyroxylin plastics to imitate natural products such as ivory, horn, tortoise-shell, onyx, mother-of-pearl and other ornamental materials

*By Joseph Rossman*

*More than any other artificial plastic of its kind, pyroxylin plastic, as exemplified by Celluloid, Pyralin, Fiberloid, Xylonite and similar materials, lends itself to the production of most excellent imitations of natural products.*

*The present review is undoubtedly the most pretentious of its kind ever compiled and will take about four months to publish. It forms a veritable library of information on this important branch of plastic materials.*

THE pyroxylin industry was founded in the United States about sixty years ago by the Hyatt brothers. John Wesley Hyatt who was a printer noticed that a collodion solution which was accidentally spilled has solidified into a dry film. Spurred on by a prize of ten thousand dollars which was offered in 1863 for an artificial substitute for ivory he experimented with collodion attempting to make imitation ivory billiard balls. Finally in 1869 the Hyatt brothers discovered that a mixture of nitrocellulose, camphor and a small amount of alchohol was thermo plastic. When heated it became soft and could be molded. After cooling to normal temperature it became hard. This method is described in their U. S. patent 105,338.

As a result of this discovery the pyroxylin plastics, known under various names as Celluloid, Zylonite, Pyralin, Fiberloid and other names, became the basis of a large industry in this country. The physical properties of Celluloid made it the favorite material as a substitute for natural products such as ivory, ebony, pearl, amber and shell. It is one of the strongest artificial materials known, having a tensile strength of 10-12,000 pounds per square inch. The pyroxylin plastics are easily worked and take a beautiful finish. It would take several pages to enumerate some of the countless uses to which this valuable material has been applied.

Pyroxylin is used in making ornaments such as bracelets, brooches, tooth brushes and other toilet articles, combs and other hair ornaments, automobile windows, buttons, knife handles, cigarette cases and holders, toys, picture frames, artificial teeth, serviette rings etc. It is used in machines, buildings, railroads and ship construction as well as for motion picture films.

Pyroxylin is particularly effective as an imitative material. It has replaced many natural materials which were difficult to obtain or were too expensive such as ivory, horn, bone, whalebone, tortoise shell, coral, pearl, ebony and other precious woods, rubber, amber, onyx, jet, malachite, lapis lazuli, jade, agate and other rare marbles. It is the object of this article to give the methods disclosed in the U. S. patents for using pyroxylin to imitate these materials.

### Artificial Ivory

The first attempts to imitate ivory were made by using collodion solutions. Charles Seely in U. S. patent 79,261, June 23, 1868 described a process for making a substitute for ivory, horn and shell as follows: One pound of gun-cotton, one-half ounce of nitroglucose are dissolved in one gallon of a suitable solvent. After the solution has become thorough and clear the solvent is evaporated in such manner as to get the solid residue in the form of a sheet or other form suitable for manufacture. The amount of solvent may be indefinitely increased or diminished without materially changing the character of the hardened product. For the sake of economy, however, the solvent should be used in the smallest quantity which can effect the solution. The purpose of the nitro-glucose is to increase the flexibility and toughness, and to counteract the brittleness of the ordinary hardened collodion. The hardness and brittleness of ordinary hardened collodion varies greatly with the different qualities of soluble cotton, and the amount of nitro-glucose should be varied accordingly, as well as to suit the specific purpose to which the product is to be put.

### Ornamenting Collodion

Attempts were also made to ornament the collodion sheets. In patent 233,973 Nov. 2, 1880 a glass plate having its surface etched with a design is covered with a solution of collodion. When dry the collodion with a solution is stripped from the glass, having on its surface an exact reproduction of the surface over which it has been flowed. For instance, if the surface of the glass was perfectly plain and smooth the surface of the film will be perfectly plain and smooth. If the glass used is made translucent by grinding the surface on which the film is made, then the film will be translucent also, presenting a ground surface similar to the surface of the ground glass, so that the surface of the film is always a reproduction or fac-simile of the surface on which it is made, and by a combination of the two surfaces mentioned pictures and other designs may be produced on the surface of the film. Any of the well-known means may be employed for faciliating the removal of the film from the surface on which it has been prepared, such for instance, as oiling or waxing the surface or smearing it with ox-gall.

*Pyroxylin plastics provided the world with an ivory substitute in such quantities that millions of elephants would have been insufficient to supply the demand.*

The process can be varied by rubbing the surface on which the design has been produced with coloring matter in powder, which will adhere to the ground surface, but not to the plain surface, and then making the film of another color or without color, in which case the result will be a contrast of color as well as transparency, or by flowing a small quantity of collodion of one color over glass prepared by etchine or engraving, and removing the superfluous collodion beyond what is sufficient to fill the depressions in the glass. A second film of another color is then placed on the first, with which it coheres.

### The Use of Ivory Dust

The Hyatt brothers obtained the first dependable imitation ivory by agglutinizing ivory dust with collodion. This is described in patent 89,582. They also obtained patents 133,229, 156,354 and 260,034 in which ivory dust, pyroxylin and camphor were mixed by grinding. A solvent was added and the materials were pressed in a mold under heat and pressure.

### Imitating the Grain of Ivory

The first patent 283,225 for a process of imitating the grain effect in natural ivory was obtained by Jarvis Edson in 1883. The process consists in forming compositions of zylonite or pyroxylin of different densities, and in some cases of slight difference in color, and then cutting them into sheets, by any of the well known processes for such manufacture, and then combining them in sheet form, by rolling them or pressing them together under great pressure, so as to compact the several sheets into one entire mass, but in such a manner as to preserve the peculiar characteristics of the structure of each separate sheet, and at the same time make such a compact body so that when cut into sheets the various sections in the sheets will show the different characteristics or grain of the original sheets of which the mass was

composed, and thereby imitate the various growths or laminated character of the ivory.

In carrying out this process two separate batches of the material, each batch being colored so as to resemble the colors of ivory are passed between heated rolls and formed into sheets of about one-sixteenth of an inch thick, a number of the sheets are placed in face to face contact and presssed together and compacted by being passed between heated rolls. The slab produced in this manner, will of course vary in size according to circumstances. It is merely necessary that it be of such a size that it can be easily cut into strips of a convenient shape to be afterward formed into a solid block. The slab is about one inch thick, and is composed of sheets of material alternating in color, firmly compacted into a substantially solid mass. This slab is cut into strips of any convenient width, according to the thickness desired in the final block of material. The strips are placed on their edges in face to face contact, and held together by means of a suitable clamping frame until a sufficient number have been accumulated, after which they are subjected to the action of a press, whereby they are formed into a solid block, from which sheets in imitation of ivory may be planed.

The main feature of the invention of patent 300,158 relates to the treatment of the strips with a solvent previous to their formation into a homogeneous block by the press. Without the solvent, the strips, whether they are composed of one or many sheets each, do not perfectly weld together, and the result is not uniform.

### The Use of a Stuffer

The grain effect of ivory is produced in the Edson patent 307,032, Oct. 21, 1884 as follows:

Two lots of semi-transparent horn-colored pure pyroxylin or zylonite base are required. With one batch is incorporated, either prior to or at the rolling operation, sufficient pigment, say of oxid of zinc about five percent and of coloring matter, say, one-half of one percent or such pigment without coloring matter. With another batch of pyroxylin is incorporated, sufficient pigment, say of about ten percent of oxid of zinc or other suitable pigment and coloring matter, about one-quarter of one percent or such pigment without coloring matter. These ingredients for giving the desired body, depth, and color, and destroying the horn like appearance of the pure material, having been thoroughly incorporated and the whole sufficiently worked on the rolls to the consistency found best adapted to the purpose, occupying about thirty minutes, the rolls are set, say, one-sixteenth of an inch apart, and the batch is run through while it is yet warm and emerges in a long sheet. This sheet is either subdivided into small areas or left intact depending upon subsequent requirements.

Celluloid Stuffing Machine By courtesy of Evarts G. Loomis Co.

These layers representing the grains of the ivory, they are then arranged and combined together. This may be accomplished in various ways. For instance the several layers may be placed upon each other and closely coiled together in scroll form and placed in what is termed a "stuffer" in this industry, similar to a lead-pipe-forcing machine; or it is obvious that, having arranged the several layers as desired, they may be assembled in other ways than the scroll form described, and subsequently passed through the stuffer.

### Variegated Effects

By the aid of heat and pressure the layers will become thoroughly welded or united, and merging from the outlet or nozzle of the stuffer in a solid form without possessing a homogeneous uniform color, but having a grain and variegated effect. This variegated effect is obtained whether the material emerges in a rod, tube, sheet, slab, or bar form. The grain effect will in this way preserve in sufficient regularity its original characteristics without being too uniform, and neither being as heterogeneous as is the case when many pieces of different colors are placed in the same stuffer and run through in the same manner. When no occasion exists for forming this grain product into rods or tubes, and it is still desired to disturb the uniformity of the layers resulting from the method of amassing them together, lengths of each of the two grades before mentioned, of, say, a yard, may be cut, and then rolled up together tightly by hand, and when sufficient of these hand made rolls are ready they are placed in a mold, and by the aid of heat and pressure consolidated into a solid cake. When this is sheeted or cut into blanks and finished, it will be found to possess a wavy grain, which is due to the amount of

(*Continued on page 94*)

# Cold Molding Speeds up Production

## Much thought and research have been expended on finding the proper resins to be used as binders for the manufacture of molded products by cold molding

*By Charles W. Rivise*

*A further contribution to our steadily growing library of collection of searches in the various arts pertaining to plastics is herewith given to the public.*

*The real value in these reviews of the development of an art such as this lies in the perspective that it gives to those who are venturing into this field, or are endeavoring to expand its horizon.*

SPEED of molding is one of the most important considerations in commercial operation. For the longer the molding composition is in the press, the greater the number of forms and molds necessary for a given output and correspondingly greater is the labor cost. Hence it is not surprising that the continued efforts of a large number of the best research workers have been devoted to devising methods for accelerating the molding operation.

### Methods of Approach

Some of the workers on synthetic resins that have the property of hardening or curing in the mold have attempted to solve the problem by increasing the sensitivity or setting speed of the composition. This expedient though it does succeed in releasing the mold much earlier than has usually been the case is open to the objection that the setting speed cannot be increased beyond a certain point without causing premature curing which results in the finished article having mealy surfaces, edges and corners. In fact some resins have been made that were so sensitive that contact with a hot mold caused setting before the mold could be closed and pressure applied to bring about uniform distribution of the mass within the mold. Of course this rendered the article entirely useless for commercial purposes.

Other investigators have directed their efforts towards modifying the molding operation itself so as to allow the removal of the article from the mold before it is completely cured. These researches have resulted in a method known as cold molding —a method that since about 1909 has been used almost exclusively shaping compositions containing natural substances such as asphalt, gilsonite or pitch.

The cold molding process is from twenty-five to fifty times as fast as hot molding methods utilizing hand molds. Certain disadvantages, however, have kept it from entirely superseding hot pressing methods. In the first place the operation is far from being complete with merely molding and shaping. Careful and protracted exposure to high temperatures is necessary to cure or harden the binding agent without causing blistering or deformation. This is partially compensated for by the fact that the baking produces great resistance to heat superior to that produced by any other known method. In the second place cold molded articles do not have the same smooth homogeneous surface and luster as hot molded articles. This fault can be minimized to a great extent by buffing and polishing or by coating the molded article with a protective coating of asphalt or phenolic condensation product as suggested in Patent 1,312,093 to Baekeland. Then again cold molded articles do not have the same exactness of dimensions and mechanical perfection as articles molded with heat. As a result of these drawbacks cold molded articles are chiefly used where cheapness and quantity are preferred to quality or where appearance is not important as for instance in the inside of electrical apparatus or instruments.

A study of the entire patent literature discloses the fact that most of the investigators have sought the solution of the problem of accelerating the molding process by modifying the known compositions so as to adapt them to cold molding processes. Many of the heat curable plastics cannot be hardened sufficiently to permit removal from the mold without the use of heat. The measure of progress made to date does not seem to have justified the efforts and zeal that have been devoted to this problem and as yet the greater portion of molding is still done by hot methods. The most likely method patented thus far appears to be disclosed by Weber in Patent 1,536,253 in which cold molding is applied to a plastic so sensitive that it would be prematurely cured if molded by a hot process. The disadvantage of Weber's process is that the preformed article must be subjected to a sec-

ond molding step in a hot mold. The abstract of this patent is given in the following collection which includes all the artificial plastics disclosed in United States patents down to April 30, 1928 that are stated by their inventors to be adapted for cold molding.

## Miscellaneous Resins

**F. G. Wiechman, Patent 883,995, April 7, 1908.**

*Method of Treating Vegetable Albumen for the Production of an Article of Manufacture Useful in the Arts and a Product.*

A protein or proteid preferably a vegetable albumen such as that obtained from the waste of the vegetable ivory nut (corozo), wheat, peas, lentils, horse beans or vetch is mixed with animal casein dissolved either in an organic acid such as acetic acid, or in an alkali such as potassium hydroxide. The vegetable albumen may be in any condition, fluid, semi-fluid, plastic or solid but preferably in a finely divided condition and in an amount to give the desired hardness to the product. The mixture is stirred or agitated with or without the application of heat. The hardness may further be increased by the addition of lime, celluloid, sulphur, rubber, indurated fiber, siccative oils, diatomaceous earth or silica clay. The color may be varied by the use of bleaching agents such as chlorine, chloride of lime or hydrogen peroxide or by the use of solid or liquid pigments. The color may also be varied by the use of heat or electricity. Vegetable casein and vegetable gluten are also mentioned as possible reagents.

**J. P. A. McCoy, Patent 1,227,465, May 22, 1917.**

*Molding Material and Process of Making the Same.*

Shellac, copal or a synthetc resin of the Bakelite type is dissolved in a weak alkaline solution such as borax, sodium hydroxide or potassium hydroxide and precipitated therefrom by means of concentrated tannic acid. The precipitate which contains the gum or resin as well as an alkali metal tannate is filtered out, washed, dried and molded with or without the usual fillers such as asbestos or wood flour. The fillers may be added to the alkaline solution of the resin. A variation is to prepare the alkali metal tannate separately and add it to the resin instead of precipitating them together.

**Wm. H. Steinberg, Patent 1,233,416, July 17, 1917.**

*Electrical Insulating Composition and Method of Making the Same.*

Reference is made to a prior patent application disclosing a composition having a base including comminuted asbestos and sulphur and a binder including coal tar pitch, stearin pitch, castor oil and benzol. The present invention has for its object the elimination of a tendency of the composition to crack when molded in certain forms. The base and the binder consist of the same substances as in the prior invention but the substances are mixed differently. The comminuted asbestos and sulphur are mixed dry and then added to the binder in the cold in preparations of four parts of base to one of binder. The binder is made as follows: Coal tar pitch and stearin pitch preferably in equal parts are mixed at a temperature of from 400° to 500°F. until the free carbon thereof precipitates. Then there is added to the heated mass a vulcanizable or polymerizable animal or vegetable oil, preferably castor oil in the proportion of 10% of the combined weight of the pitches. The supernatant liquid is drawn off and a volatile solvent added thereto in the proportion of two parts of liquid to one of solvent. The molding is carried out in the cold under pressures of 6,000 to 10,000 pounds per square inch and the molded article is subjected to a gradually increasing heat up to 500°F. for twenty-four hours.

**Wm. W. Carter, Patent 1,251,863, Jan. 1, 1918.**

*Rubber Substitute and Process of Making the Same.*

Reference is made to Patent 1,251,862 wherein a soft rubber substitute is made by mixing about two and a half parts of China wood oil and about two parts of a thick liquid consisting essentially of sulphonates derived from the so-called acids of wood tar or coal tar or both, which composition may be stabilized by a neutralizing treatment. In the present patent the process is modified by adding to the China wood oil prior to mixing with the sulphonates, a substance to prevent the composition from taking the form of the receptacle. This substance may be a tar acid, the sulphonates derived therefrom or from other sources or other fluid benzol derivatives containing a free hydroxyl or sulphonate group. The product is then subjected to a converting treatment by means of formaldehyde or hexamethylenetetramine. After allowing to stand a few hours, the supernatant liquid is removed and the residue stabilized by washing. Before drying and molding any suitable filler may be added to the composition.

**This review covers all the patents granted in the United States on the preparation of resins suitable for producing cold molded articles. They range from casein to the latest organic synthetic products.**

**Wm. T. Cushing, Patent 1,255,139, Feb. 5, 1918.**

*Electrical Insulation*

The composition consists of an inert filler or base such as asbestos or other fibrous material preferably in comminuted state and a varnish binder consisting of 20 parts of East India gum, 40 parts of China wood oil, 3 parts of rosin and sometimes 1 part of lead manganese resinate. The binder is prepared by melting the gum in the China wood oil after which the resin and lead manganese resinate are added and the mixture cooked at 400° F. The binder is then mixed in the presence of heat with a retarder such as a mixture of stearin pitch and coal tar pitch. Vegetable oils such as castor oil are also said to be good retarders. A thinner such as benzine or other volatile solvent is also added. The proportions of binder and base may be varied according to the results desired.

**J. P. A. McCoy, Patent 1,300,218, Apr. 8, 1919, Reissued as 15,199.**

*Molding Composition*

The composition consists of an inert filler such as asbestos, wood flour and a resinous binder consisting of the polymerization products of indene, cumaron or their isomers. A polymerizable vegetable oil such as China wood oil is preferably added to compensate for the shrinkage in the mold due to the expulsion of the solvent which may be used in mixing the filler with the binder or sprayed into the molding mixture prior to molding. Benzol is mentioned as a possible solvent but it is preferred to use several solvents of graded boiling points. Pigments such as lampblack or ferric oxide may be added to the composition. The mixture is dry to the touch but is plastic under great pressure.

**L. H. Baekeland, Patent 1,312,093, Aug. 5, 1919.**

*Treating Tung Oil and Coating or Impregnating Articles Therewith.*

China wood or Tung oil is heated quickly to 205° to 210° C. and held at this temperature for several hours after which it is quickly cooled. The product may be stored for further use or used at once in coating compositions or molding compositions. Fillers such as clay, silex, asbestos or wood fiber may be mixed with the oil before or after the oil is treated as described. Dyes and pigments as well as asphaltum or asphaltum compounds such as "bituminite" may also be added. The article after cold molding must be baked and is preferably coated with a protective layer of asphaltum or phenolic condensation product.

**H. R. Power, Patent 1,427,844, Sept. 5, 1922.**

*Abrasive Article*

In the prior art abrasive wheels were made of silicon carbide, emery, aloxite or corundum held together by a shellac bond which sometimes contained rosin as well as other chemicals and fillers. When rosin was used equivalent amounts of zinc oxide, lead oxide or lime were added to form resinates. Present invention is directed to substituting "cumar" which contains paracumaron and paraindene for the rosin or resinates. The composition may be cold molded.

*(Continued on page 86)*

# Testing Electrical Insulation For Power Factor and Dielectric Constant at Frequencies of From 100 to 1500 Kilocycles

## Tentative Standard, D-150-27 T of the American Society for Testing Materials

BESIDES mechanical strength resinoid insulating material must also be resistant to internal changes produced by the heating effects of high frequency alternating current. Some insulation which will withstand a fairly high voltage with direct-current will rapidly break down when subjected to alternating current. For example if two plates of a condenser are separated by a thin layer of a non-conducting material, if the frequency of the current be on the order of from 100 kilocycles upwards, sufficient heat might be developed to soften the insulating material, leading to its breakdown. With the advent of radio apparatus this is becoming increasingly important.

The test about to be described is known as D-150-27T, the figures "27" signifying the year in which the test was proposed. It is still subject to changes.

This is a Tentative Standard, published for the purpose of eliciting criticism and suggestions, and as such is subject to annual revision.

Issued, 1922; Revised, 1923, and 1927.

*In making available to our readers interested in the electrical properties of molded insulation the standards tentatively adopted by the society, we are indebted to the society for permission to publish this material.*

*The standards are subject to revision. All criticisms and suggestions should be directed to Mr. T. S. Taylor, Secretary of Committee D-9, c/o Bakelite Corp., 230 Grove St., Bloomfield, N. J.*

### Scope

1. These methods provide for the determination of the power factor and dielectric constant of solid electrical insulating materials at frequencies of 100 to 1500 kilocycles.

### DEFINITIONS

#### Power Factor

2. *Power Factor.*—The power factor of an insulating material is the ratio of the total power loss (watts) in the material to the product of voltage (volts) and current (amperes) in a capacitor in which that material is the dielectric. For the purpose of these methods the power factor shall be expressed in per cent.

#### Dielectric Constant

3. *Dielectric Constant.*—The dielectric constant of an insulating material is the ratio of the capacitance of a capacitor in which that material is the dielectric to the capacitance of a similar capacitor in which the dielectric is a vacuum. (For practical purposes air dielectric is equivalent to a vacuum.)

#### Loss Factor

4. *Loss Factor.*—For the purpose of these methods the loss factor of an insulating material is the product of its power factor in per cent and its dielectric constant.

### THEORY OF TEST

#### Power Factor

5. (*a*) *Series Notation.*—Any insulating material between two electrodes constitutes a capacitor. Such a physical capacitor may be represented by a capacitance $C$ and a resistance $R$ in *series* as shown in Fig. 1. The resistance $R$ is called the equivalent series resistance and the capacitance $C$ is called the equivalent series capacitance of the capacitor. For sine-wave voltage and current the vector relations are as shown in Fig. 2. The power factor is:

$$\text{Power Factor} = \cos \text{Theta} = \sin \text{Psi} = \sin \tan^{-1} RwC$$

where $R$ = the resistance in ohms;

$w$ = 2 Pi times the frequency in cycles; and

$C$ = the capacitance in farads.

Since, for small angles the sine is substantially equal to the tangent, the power factor equals $RwC$, approximately. This is correct to closer than 0.5 per cent of the power factor value for power factors up to 0.1 or 10 per cent. Where $R$ is expressed in ohms, $C$ in micro-microfarads, the frequency, $f$, in kilocycles, and the power factor in per cent, this expression becomes:

$$\text{Power Factor in per cent} = 6.28\ RCf \times 10^{-7}$$

The power factor is, therefore, determined by measuring the values of $R$ and $C$. This may be

(*Continued on page 78*)

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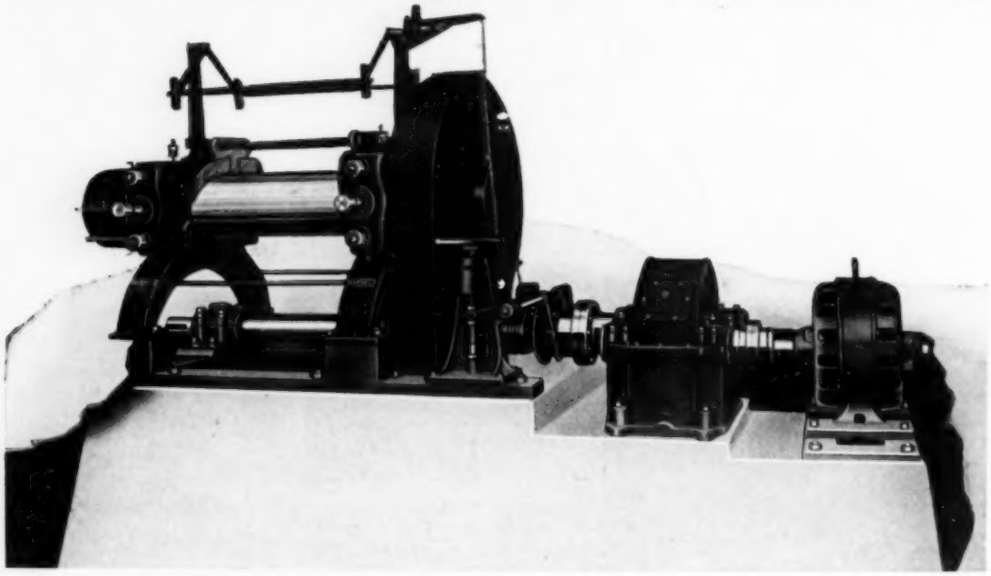

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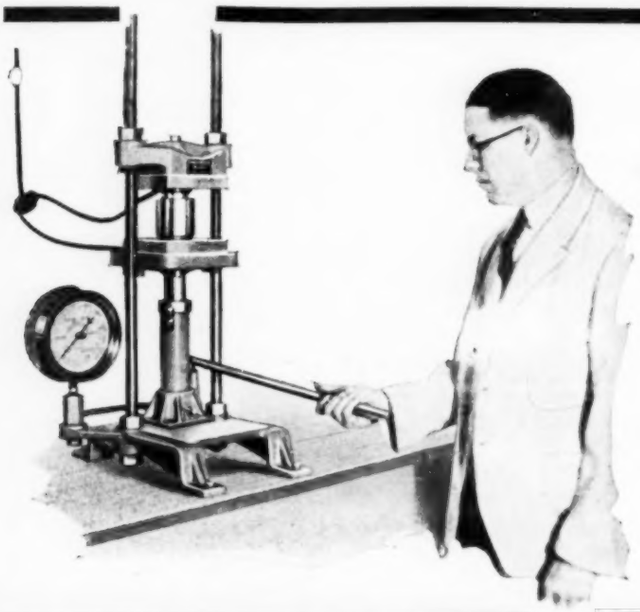

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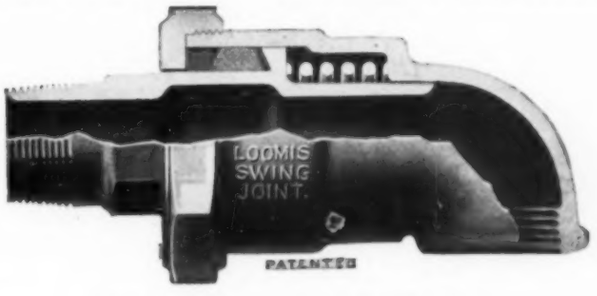


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# Testing Insulation at High Frequencies

(*Continued from page 74*)

done by the Substitution Method as described in Section 14 and 15.

(*b*) *Parallel Notation.*—A physical capacitor may also be represented by a capacitance *C prime* and a resistance *R prime* in *parallel* as shown in Fig. 3. The resistance *R prime* is called the equivalent parallel resistance and the capacitance *C prime* is called the equivalent parallel capacitance of the capacitor. For sine-wave voltage and current the vector relations are as shown in Fig. 4. For this notation the power factor is:

$$\text{Power Factor in per cent} = 1.59\,\frac{G\,10^4}{fC_p}$$

It will be seen that *G* and *C prime* determine the power factor. They may be measured by the Bridge Method as described in Sections 1 9and 20.

The equivalent series capacitance *C* as determined by the Substitution Method, Sections 14 and 15, and the equivalent parallel capacitance *C prime* as determined by the Bridge Methods, Sections 18 and 19, are not identical; but for power factor up to 10 per cent they are equal to within 1 per cent. Either value may be used in calculating the dielectric constant.

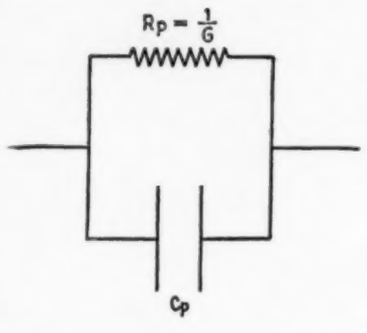


*Fig. 3. Equivalent Parallel Circuit*

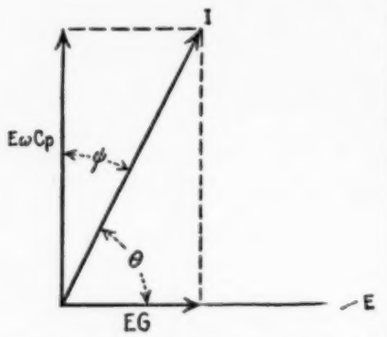


*Fig. 4. Vector Diagram for Equivalent Parallel Circuits.*

$$\text{Power Factor} = \cos \text{Theta} = \sin \text{Psi} = \sin \tan^{-1}\frac{G}{wC_p}$$

where *G* = the conductance in *mhos;*

*w* = 2 pi times the frequency, in cycles; and

*C prime* = the capacitance in farads.

Making the same approximations as in Paragraph (*a*), the power factor for practical purposes is taken as $\frac{G}{wC_p}$. Where *G* is expressed in micro-mhos, the frequency, *f* in kilocycles, *C prime* in micro-microfarads, and the power factor in per cent, this expression becomes:

### Dielectric Constant

6. The dielectric constant *K* may be computed from the relation:

$$\text{Dielectric constant } K = \frac{(C - C_e)\,t}{0.0885A}$$

where *t* = the average thickness of dielectric between electrodes, in centimeters;

*A* = the contact area of either of the equal electrodes in square centimeters;

*C* = the measured capacitance in micro-microfarads;

$C_e$ = the edge correction obtained from the curve in Fig. 5.[1]

The determination of *E equal the square root of C* requires a knowledge of the approximate value of *K* which can always be obtained by making a preliminary calculation, neglecting *E equal the square root of C* in the above formula. For thickness *t*, in inches, and area *A*, in square inches, the above formula becomes:

$$K = \frac{(C - C_e)\,t}{0.224\,A}$$

### Loss Factor

7. The total power loss per unit volume of insulating material for a stated frequency, voltage gradient, and temperature, is proportional to the product of the power factor in per cent and dielectric constant. Therefore, the loss factor is defined as:

Loss Factor = Power Factor in per cent X Dielectric constant *K*

## TEST SPECIMENS

### Molded or Sheet Materials

8. (*a*) For testing molded or sheet materials the test specimen shall be either a disk 6 in. (15.24 cm.) in diameter or a square 6 in. (15.24 cm.) on a side. The thickness shall preferably not be less than 0.1 in. (0.254 cm.) nor more than 0.3 in. (0.762 cm.). The thickness shall be uniform to ± 5 per cent, and the surfaces shall be smooth and free from irregularities. Other thicknesses may be used where it is desired to test materials of the various thicknesses in commercial use. In any case, the capacitance of the specimen shall preferably not be less than 100 micro-microfarads.

### Insulating Films

(*b*) For testing films of insulating varnish, lacquer, or paints, the test specimen shall be prepared as specified for the Appendix to the Tentative dielectric strength tests in the Methods of Testing Insulating

1. See p. 82.

(*Continued on page 82*)

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# Plasticizers in the Plastic and Lacquer Field

## Essential qualities of a good plasticizer for the cellulose esters, and the development of special types for the acetyl derivatives. Relation between chemical and physical properties and plasticizing quality.

*By T. S. Carswell*

*Research Department of the Monsanto Chemical Works, St. Louis, Mo.*

THE use of plasticizers in producing cellulosic compositions originated in 1870, when John W. Hyatt patented the use of camphor for producing plastic masses with nitrocellulose. Since that time a number of other substances have been developed as nitro-cellulose plasticizers; and the recent introduction of acetyl cellulose into the lacquer and plastic field has necessitated the development of new and suitable plasticizers for acetyl cellulose. The growing popularity of cellulose plastics indicates that the manufacture of suitable plasticizers will ultimately constitute an important portion of the synthetic organic chemical business.

A plasticizer is a chemical compound, or mixture of compounds, which when mixed with the cellulose ester forms with it a colloidal solution. The resulting combination has properties which are different from and more valuable than the cellulose ester alone. For example, an acetyl cellulose film without any plasticizer is brittle and has no mechanical strength; with the proper plasticizer the film becomes tough and ductile. The properties of the cellulose film are greatly influenced by the type and quantity of plasticizer present; among the properties so influenced may be mentioned hardness, viscosity, ductility, adhesiveness, rubbing qualities, water-resistance, resistance to chemicals and to fats and oils, electrical insulating value, and the ability of the plastic to take fillers and dyes. In lacquer work, the plasticizer is really of greater importance than the solvent for the latter ultimately evaporates and the qualities of the resulting film depend on the plasticizer which is left behind.

*This article was presented as a paper read before the St. Louis section of the American Chemical Society on December 3d, 1928 and is published in Plastics by special permission, as an original contribution.*

### Prime Requirements

A satisfactory plasticizer for cellulose esters must come up as nearly as possible to the following requirements:

1. It must have good solubility for the cellulose ester.
2. It must have little inflammibility.
3. It must be colorless and odorless, and not change color on exposure to light.
4. It must be stable against the action of cold, moderate heat, or moisture.
5. It must have no tendency to crystallize or separate out of the film.
6. It must have a high boiling point and be practically non-volatile at ordinary temperatures.
7. It must have low acidity in order not to hydrolyze the cellulose ester.

In addition to meeting all of these qualifications, a plasticizer for practical purposes must not be too expensive. Patent literature on plasticizers mentions many substances which will meet one or more of these qualifications, but there are relatively few which fulfill all of these requirements.

### Nitro-Cellulose Plasticizers

As a general rule, plasticizers which are suitable for nitro cellulose are not equally well adapted for acetyl cellulose. For example, camphor, which was the first of all the plasticizers, has no value at all as a plasticizer for acetyl cellulose since it has no solvent power for the latter.

Among the more important plasticizers for nitro cellulose compositions may be mentioned the alkyl phthalates, such as dibutyl and diamyl phthalate, diethyl—diphenyl urea, tetra alkylated ureas, triphenyl and tricresyl phosphate, ethyl acetanilide, and toluene sulfonamide derivatives. These compounds all have their advantages in respect to the properties which they impart to the film. Camphor is an ideal plasticizer from the point of view of solubility, cost (current market) and stability, but it has serious disadvantages in having odor and appreciable volatility. The latter is particularly a disadvantage in lacquer work, since the plasticizer will rapidly evaporate out of a thin film and leave behind a brittle mass. Ethyl acetanilide, known under the trade name of Mannol has even greater solubility for nitrocellulose than camphor. The esters of phosphoric acid are particularly valuable in reducing the flammability of the film, and they

are often used in connection with other plasticizers to produce a "safe" film. The most widely used of these is tricresyl phosphate, which is manufactured under the trade name of Lindol. The alkyl phthalates are among the most widely used nitro-cellulose plasticizers; they have the particular advantage of being inexpensive. The toluene sulfonamid derivatives were originally developed as acetyl cellulose plasticizers and they will be spoken of in more detail later. We find, however, that they are of considerable value as nitrocellulose plasticizers. They are particularly valuable in that they have low volatility and good stability to light and moisture.

### Acetyl Cellulose Plasticizers

The principal plasticizers for acetyl cellulose are tri-phenyl or tri-cresyl phosphate, triacetin, alkyl acetanilides, and sulfonamide derivatives. As in the case of nitro-cellulose film, the phosphoric acid esters have the property of making the film noninflammable; in other respects, however, they are not so well adapted for use as acetyl cellulose plasticizers. Triacetin has a serious disadvantage in that it is appreciably soluble in water, and is rather easily hydrolyzed. The most important group of acetyl cellulose plasticizers are the sulfonamid derivatives, and they are described in detail.

At the present time, there are four different types of sulfonamide derivatives which find extensive commercial application. These are: (1) p-toluene-sulfonanilide, which is a white crystalline product with a melting points of 102°C and is manufactured in this country under the name of Santicizer H-1; (2) a mixture of ortho and para toluene sulfonamides, melting at about 100°C and manufactured in this country under the name of Santicizer H-9; (3) the ethyl derivative of p-toluene sulfonamide, which in its commercial form is a wax-like solid of melting point about 50°C, manufactured under the name of Santicizer H-3. (4) a mixture of the ethyl derivatives of ortho and para toluene sulfonamides, which forms a clear liquid at room temperature, manufactured under the name of Santicizer H-8. These plasticizers all give with acetyl cellulose, compositions which have different properties; for example, p-toluene sulfonanilide is relatively inexpensive and has good solubility for acetyl cellulose, but films made from it have the undesirable property of turning dark when exposed to light for a considerable length of time. The ethylated toluene sulfonamides are particularly good in respect to light fastness. We have exposed films containing ethyl derivatives of the toluene sulfonamides for as long as 1500 hours in the Fade-O-Meter, equivalent to 4 or 5 years in direct sunlight, before any change in color took place.

The toluene sulfonamide plasticizers are particularly valuable in that they have very low vapor tension, and consequently their volatility is negligible. For example, the vapor pressure of p-toluene ethyl sulfonamide is only about 10 mm at 200°C; at ordinary temperatures the vapor-pressure is entirely too small to be measured. Consequently, these plasticizers do not evaporate from the film.

### Relation between Chemical and Physical Properties and Plasticizing Quality

We must admit that there is no way to tell whether a given compound will have any plasticizing qualities, except to try it out with the particular cellulose ester for which it is intended. As far as we can tell, there is no relationship between the physical properties of a chemical compound and its value as a plasticizer.

In the patent literature there is some attempt to correlate melting point with plasticizing quality, and it is claimed that mixtures which are liquid at ordinary temperature are better plasticizers than those which are solid. While this may be true in certain cases, it is not a generally applicable rule—good films can be obtained with the solid plasticizers which we have mentioned above. It is true, however, that there are relatively few good plasticizers with a very high melting point—say over 100°C. As a general rule, high melting compounds have poorer solubility and show greater tendency to separate out of the film than those with lower melting points. Camphor, of course, is a classic exception to this statement. For many purposes, however, a high melting plasticizer is desirable from the point of view of the manufacturer of cellulose plastics.

### Inexplicable Diversity

In order to illustrate how little relationship there is between physical properties and plasticizing quality, let us consider the case of two substances with very similar physical properties; p-toluene sulfonanilide, which has a melting point of 102°C and a molecular weight of 247, and symmetrical diphenoxy ethane, whichs has a melting point of 98°C and a molecular weight of 214. Both are readily soluble in acetone, which is the usual acetyl-cellulose solvent. Yet the first of these compounds is a good plasticizer and gives an excellent film, while the second is not a plasticizer at all, and separates out of the film immediately once the solvent evaporates.

### Homologs

It cannot be definitely predicted from the chemical constitution, any more than from the physical properties, whether a certain compound will be a plasticizer or not. There is, however, some relationship between the chemical constitution and the plasticizer quality, in members of homologous series. For example, in a series of different alkyl derivatives of the sulfonamides, running from p-toluene methyl sulfonamide to p-toluene amyl sulfonamide, there is a tendency to decrease in solvent power for acetyl cel-

(*Continued on page 93*)

## TESTING INSULATION

(*Continued from page 78*)

Varnishes (Serial Designation: D 115 — 26 T) of the American Society for Testing Materials. The copper or brass plate shall be one capacitor plate, and tinfoil the other. Both varnish films may be tested individually.

**Conditioning of Test Specimens**

9. Before the specimens are tested, they shall be kept for 48 hours under uniform atmospheric conditions. Unless otherwise specified, these conditions shall be a relative humidity of 60 per cent and a temperature of 20 to 30° C. A satisfactory method of maintaining constant humidity is given in Section 12 of the Tentative Methods of Test for Surface Resistivity and Volume Resistivity of Solid Insulating Materials (Serial Designation: D 257 — 26 T) of the American Society for Testing Materials.

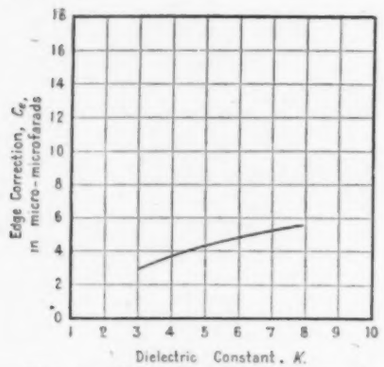



*Fig. 5. Edge Correction curve for 4.5 inch diameter electrodes* (*see p. 78*).

**Electrodes**

10. (*a*) The electrodes shall consist of tin or lead-foil disks 4.5 in. (11.43 cm.) in diameter and approximately 0.001 in. or 0.002 in. (0.025 or 0.050 mm.) in thickness. They shall be applied to the surface of the specimen and shall be accurately centered with respect to each other and approximately with respect to the specimen. A very thin coating of petrolatum shall be used as an adhesive.

(*b*) For testing materials of thickness less than 0.1 in. (0.254 cm,), such as thin-sheet insulating materials and films of insulating varnish and lacquer, the electrode area may be adjusted to give any convenient capacitance above 100 micro-micro-farads. When calculating the dielectric constant of such materials, the edge correction should be omitted.

### PROCEDURE

**Method**

11. (*a*) The method of measurement may be either the substitution method as described in Section 12, 13, 14 and 15, or the Bridge method as described in Section 16, 17, 18, 19 and 20.

**Measurements**

(*b*) The power factor and dielectric constant of at least two specimens shall be measured at such frequencies as may be mutually agreed upon between the supplier and the purchaser. Unless otherwise agreed upon the frequencies shall be approximately 100 kilocycles and 1000 kilocycles.

#### *A. Substitution Method*

APPARATUS

**Generating Circuit**

12. *Oscillator.*—The generating circuit for the Substitution Method shall consist of an oscillator (preferably a vacuum tube) which is the power source. This oscillator shall be designed so as to be easily adjustable over a range of frequencies from 100 to 1500 kilocycles, and shall have a power rating sufficient to prevent any reaction or frequency or voltage output coupled to the measuring circuit. The oscillator output shall be of approximately sine-wave form, having not more than 5-per-cent harmonic components. The oscillator shall be well shielded. The entire apparatus shall be installed in a well-shielded room or so located as to be free from interference.

**Measuring Circuit**

13. The measuring circuit is shown in Fig. 6 and shall consist of the following parts:

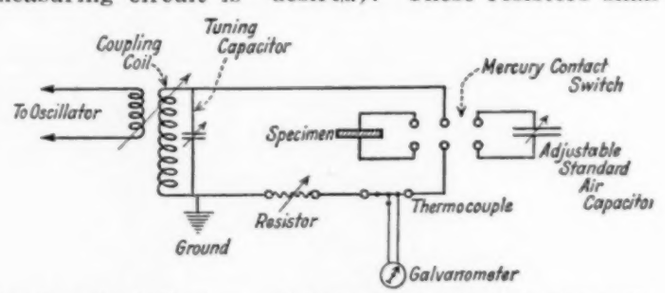



**Fig. 6 Measuring circuit diagram used with the substitution method.**

*Coupling Coils.* — Several coupling coils so designed as to tune over the required frequency range to within 1 per cent of the frequency desired. For convenience in tuning, an adjustable air capacitor of about 0.001 micro-farads capacity (tuning capacitor) may be connected across the coupling coil. This tuning capacitor should be of the same sensitivity of adjustment as the standard air capacitor, but no calibration is necessary.

*Capacitor.* — An adjustable standard air capacitor having a capacitance of about 0.001 microfarad capable of being read to 0.5 micro-microfarad. This capacitor shall be calibrated for capacitance and power factor over the required frequency range.

*Switch.*—A special high-frequency switch of the mercury contact type having mercury cups mounted on Pyrex or quartz tubes 4 to 6 in. (10 to 15 cm.) in length. This switch shall be a double-pole, double-throw, with copper switch blades well amalgamated with mercury.

*Thermocouple Galvanometer.* —The thermocouple shall have a low heated resistance, preferably less than 2 ohms, and be sufficiently sensitive for use with a suitable galvanometer. The galvanometer shall be of low resistance and short period and shall be operated critically damped. It shall have a sensitivity of approximately 120 mm. per micro-ampere at a scale distance of 1 meter.

*Resistors.*—Several resistors made of short, straight lengths of non-magnetic resistance wire (advance or manganin is preferable) sealed into glass tubes (which may be evacuated if desired). These resistors shall all have approximately the same length. For most work, 30 resistors to cover a range of 0.2 to 60 ohms will suffice. When resistance values higher than 60 ohms are required, a 3-dial 1000-

ohm-reactive decade box may be used.

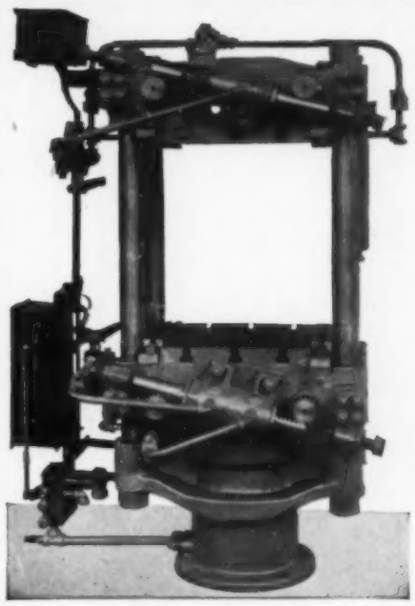
### METHOD

#### Operation

14. With the specimen connected to the measuring circuit through the mercury contact switch, the circuit shall be turned approximately the desired frequency by proper selection of the coupling coil. The circuit may be brought into exact resonance by adjusting the frequency of the oscillator, or by means of the tuning capacitor if the latter is used. Resonance is indicated by maximum deflection of the galvanometer. The coupling to the oscillator shall be varied at the same time so that with no resistance inserted in the measuring circuit, approximately a two-third scale deflection of the galvanometer is obtained.

The adjustable standard air capacitor and a resistor shall then be substituted for the specimen. The resistance should be so chosen that when the measuring circuit is tuned to resonance by adjusting the standard air capacitor, a maximum deflection will be obtained on the galvanometer which is approximately the same as that previously produced by the specimen. Four resistors shall then be chosen having resistance values such that when inserted in the circuit, two will give deflections above and two below the deflection produced by the specimen. The deflections obtained with these four resistors shall be plotted against their resistance values. From this curve the equivalent series resistance $R$ of the specimen shall be obtained by reading the value of resistance corresponding to the deflection produced by the specimen and adding to it the value of the resistance of the standard capacitor at the capacitance and test frequency used.

When a decade resistor is used, the procedure is the same as above except that it is sufficient to adjust the resistor to obtain a deflection equal to that produced by the specimen. The

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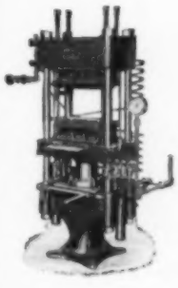

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equivalent series resistance $R$ is then equal to the dial reading of the resistance box plus the resistance of the standard air capacitor at the capacitance and test frequency used.

The capacitance reading of the standard air capacitor corrected for lead capacitance is the equivalent series capacitance $C$ of the specimen.

The frequency shall be determined after the final tuning.

**Calculations**

15. Calculations for power factor shall be made as described in Section 5 (*a*). Calculations for dielectric constant and loss factor shall be made as described in Sections 6 and 7, respectively.

*B. Bridge Method*

APPARATUS

**Generating Circuit**

16. The generating circuit for the Bridge Method shall be the same as for the Substitution Method as described in Section 12.

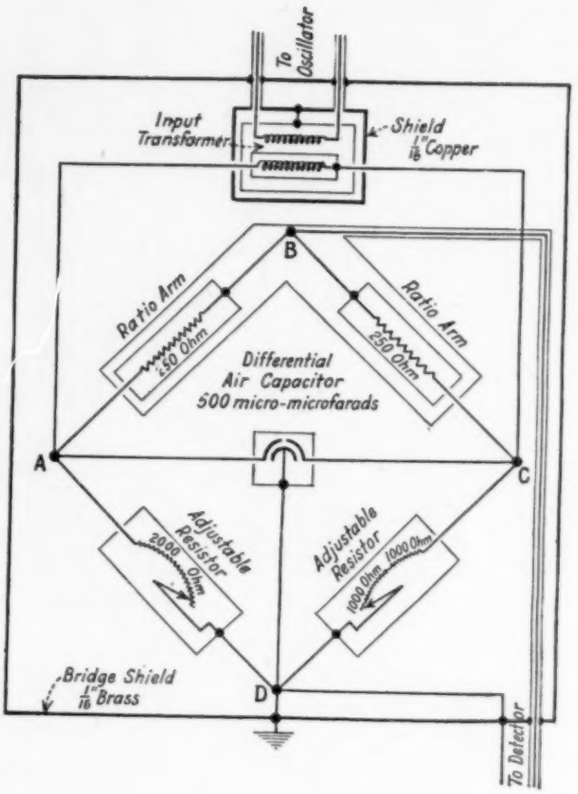
Note.—The oscillator does not need to be of as high a power output for the Bridge Method as for the Substitution Method.

**Measuring Circuit**

17. The measuring circuit is shown in Fig. 7 with necessary shielding as indicated, and shall consist of the following parts:

*Balanced Resistors.*—One pair of balanced non-reactive resistors or ratio arms, *AB* and *BC*, each of approximately 250 ohms resistance, and enclosed in an electrostatic shield as shown in Fig. 7. These arms shall be balanced for resistance to within 0.05 of 1 per cent, and for reactance to within 0.1-micro-microfarad equivalent parallel capacitance.

*Adjustable Resistors.*—Two non-reactive adjustable resistors each shielded as shown, for use in the *AD* and *CD* arms of the bridge. The *CD* arm resistor shall comprise two 1000-ohm steps. The *AD* arm resistor shall be a four-dial decade box having steps of 0.1, 1, 10, and 100 ohms, with an additional 1000-ohm step. Precision type, high-frequency commercial resistances are satisfactory for use in these resistors.




**Bridge Method**

*Circuit diagram for determination of power factor and dielectric constant of electrical insulating materials subjected to high frequency electrical stresses.*

(*Fig. 7*)

*Differential Air Capacitor.*—One differential air capacitor of 500-micro-microfarad capacitance, total variation. For convenience it is desirable to provide a vernier capacitor adjustable to 0.01 micro-microfarad. These capacitors shall be calibrated to read the capacitance inserted in the *CD* arm.

*Input Transformer.* — One shielded input transformer[1] adapted to the connection of a 250-ohm impedance to the oscillator.

**Detector Circuit**

18. The detector circuit shall consist of any suitable detector of sufficient sensitivity to indicate an unbalance of 0.1 ohm in the *AD* bridge arm. A heterodyne type used with a telephone receiver will be found satisfactory.

METHOD

**Operation**

19. Suitable leads for connecting to the specimen shall be connected to terminals *C* and *D* of the bridge, Fig. 7, but not to the specimen. The bridge shall then be balanced by adjusting the differential air capacitor and the adjustable arm resistor *AD*. The capacitance and resistance values are then recorded as $C_0$ and $R_0$. These readings shall be taken to compensate for the capacitance in the bridge and lead wires. The specimen shall then be connected to the lead wires, and the bridge balanced again. The capacitance and resistance values are recorded as $C_1$ and $R_1$. The equivalent parallel capacitance of the specimen is: $C\ prime = C_1 - C_0$, and the conductance $G = \dfrac{R_0 - R_1}{R_0 \times R_1}$.

By properly adjusting the value of $R_0$, $G$ and be made substantially equal to $R_0 - R_1$ times some power of ten.

The frequency shall be determined when the bridge is finally balanced.

**Calculations**

20. Calculations for power factor shall be made as described in Section 5 (*b*). Calculations for dielectric constant and loss factor shall be made as described in Sections 6 and 7, respectively.

**Accuracy**

21. The accuracy of the power factor and dielectric constant determinations by the above

methods depend critically upon the care exercised in setting up the measuring equipment and in its subsequent manipulation. The technique exercised in these respects shall be such that an accuracy within ± 10 per cent for the determination of power factor, and within ± 5 per cent for the determination of dielectric constant shall be obtained.

22. The report shall include the following:

(*a*) The percentage power factor, the dielectric constant, and the loss factor of each specimen.

(*b*) The following values for the specimen: the capacitance of the specimen in microfarads; effective area of the specimen; and the average thickness of the specimen electrodes.

(*c*) The following test conditions: the frequency in kilocycles; temperature of the atmosphere in degrees Centigrade; relative humidity of the atmosphere in per cent; and the conditioning of the specimen (hours at humidity and temperature).

(*d*) A description of the material: that is, the name, grade, and color, and the name of the manufacturer.

(*e*) Method of measurement.

*Another test, D175-25 T, for testing insulation at frequencies even higher than those above described, namely at radio frequencies will be taken up in the next installment of this series.*

**Further research work on new cellulose compounds, according to patents granted to Leon Lilienfeld will be described in the next issue of PLASTICS.**

## Propionic Acid Produced by Fermentation of Sugar and Lactic Acid

A monograph on the propionic acid bacteria, which produce propionic acid from sugar or lactic acid, has just been published by Dr. C. B. van Niel, of the Technical High School at Delft, Netherlands. It contains a summary of the present state of our knowledge of these somewhat neglected organisms and a particularly exhaustive chemical and bacteriological study of their properties. Reference is made by Dr. van Niel to the view expressed by the American bacteriologist Sherman that the commercial production of propionic acid would be followed by its utilization in considerable quantities. Propionic acid is an acid allied in properties to acetic acid but having a higher boiling point.

The use of ethyl propionate as a solvent for pyroxylin has been patented in America, while cellulose propionate has been suggested as an alternative to celulose acetate. Most of the propionic acid available at present is obtained from the higher fractions of crude acetic acid (pyroligneous acid) arising from the distillation of wood. At present it is almost entirely used in the manufacture of synthetic perfumes and flavoring essences. Propionic acid, unlike acetic acid, has the advantage of remaining liquid over a wide range of temperature.

Dr. van Niel's experiments lead him to the conclusion that no insurmountable difficulty should be encountered in the large-scale preparation and production of propionic acid by fermentation of milk-whey or other products containing sugar. The results of his researches indicate that the slow rate of fermentation, which is a disadvantage, may be overcome by a suitable procedure.

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# Resins for Cold Molding

(*Continued from page 73*)

**C. Ellis, Patent 1,514,508, Nov. 4, 1924.**

*Amorphous Product and Method of Making Same.*

Twenty pounds of acetone, fifty pounds of formalin and five pounds of sodium carbonate are mixed and heated under reflux condenser. The resulting product is freed from water, dried, dissolved in wood alcohol and a caustic alkali such as sodium or potassium hydroxide added to catalyze the change to the final form. It is incidentally stated that a large amount of caustic will result in a cold molding composition. Fillers such as wood flour, linters, asbestos, flock or mineral powders, casein, starch, natural or synthetic resins, fluxes, mold lubricants and other extending or modifying materials may be added to the composition.

**C. Ellis, Patent 1,541,336, June 9, 1925.**

*Cold Molded Product and Process of Making Same.*

Composition consists of a filler such as asbestos, sawdust, wood flour, talc, cotton flock or mixtures thereof and a binder comprising a complex formed by reacting on glycerol with a natural resin such as rosin or copal resin and an organic acid or anhydride such as phthalic, citric, tartaric, malic, maleic, or succinic. A small amount of drying oil such as Chinese wood oil, linseed oil or fish oil may be added as well as extending or cheapening materials such as pitch, asphalt, mixtures of asphalt, gilsonite and stearine pitch and retarding agents such as glucose, glycol or glycerol.

**G. J. Votapek, Patent 1,574,771, Mar. 2, 1926.**

*Plastic Composition Material and Method of Producing the Same.*

The composition consists of a filler such as asbestos and a binder comprising the reaction product of an organic body such as phenol or cresol and an inorganic substance such as a halogen derivative of an element of the sulphur type, as for example a chloride of sulphur or selenium monochloride. The product may be considerably improved by incorporating a small quantity of stearin pitch as suggested in Patent 1,233,415 to Steinberg in the binder before adding the filler. The incorporation of the filler may be facilitated by the addition of a solvent such as acetone or coal tar oil. Before molding the composition is comminuted and screened.

**J. P. Trickey & C. S. Miner, Patent 1,665,235, April 10, 1928.**

*Furfuralcohol Resins*

A small quantity of hydrochloric acid (.1%)) or sulphuric acid is added to furfuralcohol with heat. The reaction may be regulated by maintaining the temperature of the mixture at about 100° C., by adding water to the alcohol, or by varying the quantity of catalyst and may be carried out with pressure. It is even possible to omit the catalyst. The product in its viscous or liquid form or dissolved in suitable solvents may be used to impregnate fillers for use as molding compositions.

## Phenol Aldehyde Resins

**J. W. Aylsworth, Patent 1,090,439, Mar. 17, 1914.**

*Composition*

A fusible phenol resin is dehydrated and mixed with a volatile solvent such as methyl or ethyl alcohol or acetone. To the solution are added a hardening agent such as hexamethylenetetramine and a filler such as wood flour, powdered infusible phenol condensation product, cotton flock or suitable mineral fillers such as clay, barium sulphate, plaster of Paris, silica or zinc oxide. A solvent may be dispensed with by mixing the resin and hardening agent on mixing rolls or by otherwise finely powdering the mixture. The mass is dried, powdered and mixed with plasticity agents such as eugenol, mono-chloro-naphthalene, monochlorophenol, phenol, cresol, acetylene-tetra-chloride, oil of mirbane, oil of camphor or mixtures thereof. In the case of phenol, cresol, eugenol or monochlorophenol additional hardening agent should be added to the solution or to the phenol before adding the latter to the mass. Pigments or dyes may also be incorporated.

The fusible phenol resin may be made as in Patents 1,106,631; 1,020,593 and 1,029,737.

**J. W. Aylsworth, Patent 1,111,288, Sept. 22, 1914.**

*Production of Plastic Masses*

A water soluble phenol formaldehyde condensation product is formed by reacting on phenol or cresol in presence of alkaline earth oxide or hydroxide such as those of barium, strontium or calcium (lime), either in equi-molecular proportion of oxide or less. The product is largely composed of phenol alcohols such as oxybenzyl-alcohol. The metallic oxide may be neutralized either prior or subsequently to incorporating fillers and the neutralizing agents are preferably those that form insoluble insulating salts with the oxide such as sulphuric or carbonic acid. The precipitated salt may be filtered out if desired. Among the fillers mentioned are wood flour, asbestos, cotton flock, etc.

**E. Hemming, Patent 1,125,906, Jan. 19, 1915.**

*Cold Molding of Phenolic Condensation Products.*

The reaction between phenol, formaldehyde and a condensing agent of basic, neutral or acid nature, preferably ammonia, is allowed to proceed until the specific gravity is between 1.15 and 1.21 and the water layer is then drawn off. The product is thinned with a solvent such as glycerine, alcohol or acetone and a filler such as asbestos added.

**J. P. A. McCoy, Patent 1,286,370. Dec. 3, 1918.**

*Process of Molding*

An insoluble and infusible resinous condensation product such as Bakelite or a natural insoluble pitch such as gilsonite or wurtzilite is treated in powdered condition with a common solvent such as methyl alcohol or benzol or mixture thereof to cause it to swell slightly and the mass is subjected to pressure in the cold. Binder may be mixed with inert filler such as finely divided asbestos or wood our. A soluble binder may be used as well as shellac or coal tar; in the latter case the binder is first heated to expel the volatile constituents. Then binder or the solvent may be applied in vapor or liquid vapor.

**F. Grunwald, Patent 1,330,444, Feb. 10, 1920.**

*Process of Manufacturing Electric Insulating Molded Articles.*

Condensation product of phenol and formaldehyde in the plastic stage is mixed with a flaky filling material such as asbestos, sawdust, etc. and enough water or a mixture of water and benzine added until the mixture becomes flaky. The mass is cold molded, dried and heated in an oven until the material is cured. Other liquids having a boiling point and vapor tension near those of water may be used, e. g. benzol.

**L. V. Redman, A. J. Weith and F. P. Brock, Patent 1,339,134, May 4, 1920.**

*Method of Molding Condensation Product.*

A filler such as wood flour, mica, asbestos pulp or fiber or mixture thereof is moistened with a solution of hexamethylenetetramine, hydrobenzamide or benzaldehyde amine in an unreacted phenol such as the cresols or xylenols. A potentially reactive phenolic condensation product preferably in pulverulent anhydrous form is then added. The condensation product may be a fusible product of phenol and hexa and may be dissolved in acetone or alcohol or a mixture of solvents with or without water. It may be made by heating cresol and formaldehyde or hexa, eliminating the free reagents, adding creosote oil and pigments or coloring matter and finally stirring in hexa dissolved in cresote oil with or without fats, fatty acids or waxes and breaking up the mass. A variation is to dissolve hexa in cresol and mix the same with asbestos pulp and fiber. Copal, kauri or other natural resin, asphalt or coal tar pitch dissolved in benzol may be added to increase stiffness and coherency. In any case creosote oil may also be added.

**L. T. Richardson, Patent 1,342,067, June 1, 1920.**

*Method of Making Molded Products*

Method consists in heating in proportions to afford about one methylene group to each phenolic group. an anhydrous phenolic body such as phenol, cresol or xylenol and anhydrous hexamethylenetetramine, benzaldehyde amine or hydrobenzamide; arresting the reaction and lowering

the temperature by the addition of a high boiling point solvent such as coal tar oil or shingle stain oil when the reaction is about one-third completed; mixing the product together with a filler such as asbestos, mica, flock or wood pulp; comminuting the mass and molding into desired shape under great pressure with or without heat after which the article is subjected to a gradual rise in temperature until cured.

**Wm. T. Cushing, Patent 1,358,297, Nov. 9, 1920.**
*Method of Cold Molding Composite Materials.*

A material comprising an asbestos base an a Bakelite "A" binder is molded to a slab of the final desired shape, then cut away on its margins, the severed portions being removed and the slab then repressed into its desired shape. If desired the mass may be molded into one shape, then remolded into another or initially into the same shape as the final product but with a difference in dimensions. This process is said to increase the mechanical strength of the product and is used for making electrical insulation.

**L. V. Redman, A. J. Weith, F. P. Brock, Patent 1,358,394, Nov. 9, 1920.**
*Method of Molding Condensation Product.*

The method consists in mixing together a filler such as asbestos, mica, flock, wood pulp or a mixture of any of them with a substantially anhydrous phenolic condensation product corresponding to the reaction between a phenol, cresol or xylenol and a methylene body such as formaldehyde or hexamethylenetetramine in proportions affording at least two phenolic groups to each methylene group and adding an non-volatile methylene body such as hexa or hydrobenzamide in sufficient quantities to give to the molding mixture about one methylene group to each phenolic group. Preferably a high boiling solvent such as creosote oil obtained by the distillation of coal tars or asphalts may also be mixed with the composition.

**J. P. A. McCoy, Patent 1,425,784, Aug. 15, 1922.**
*Insulating Composition and Insulator Made Therefrom.*

Invention is directed to substituting part of the Bakelite in an insulating composition with the partially polymerized products of indene, cumaron, paracumaron, paraindene or their isomers in order to cheapen the product and to prolong the hardening. A specific example is given wherein the filler such as ground asbestos forms 90% of the composition and the mixtures of resins 5%, the remaining 5% being raw China wood oil to compensate for the shrinkage due to the expulsion of the solvent during curing. The ingredients are mixed into a pulp or sludge with a suitable solvent such as benzol, or a mixture of solvents graded as to boiling points and preformed while cold in a mold of the desired shape but of larger size. Any desired coloring matter or pigment may be added to the mixture.

(*Continued on page 91*)


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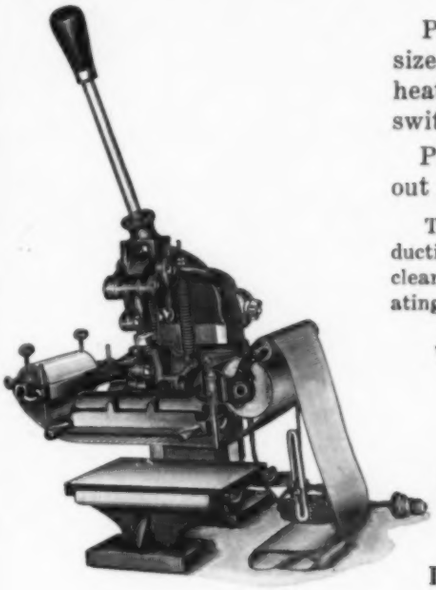

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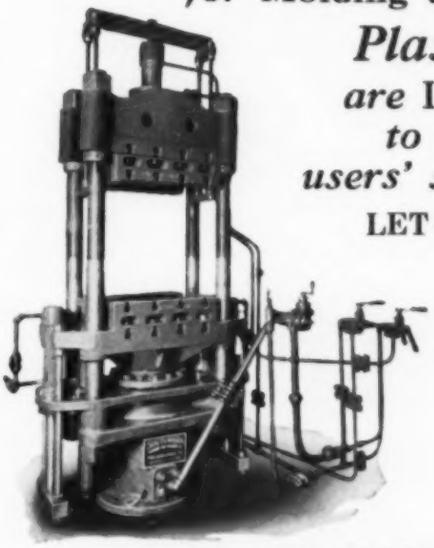

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# Technical Abstract Section

## A Concise Review of Patents and Literature

### Cellulose Compositions

**Process of Making Cellulose Acetate.** Edward S. Farrow, Jr., assignor to Eastman Kodak Company, Rochester, N. Y. U. S. P. 1,679,966; Aug. 7, 1928.

1. The process of making cellulose acetate, which comprises treating cellulosic material with an aqueous solution of hydrochloric acid having a concentration greater than 25% and free from oxidizing agents at room temperature for two to six hours, the action being stopped before the physical appearance of said material is appreciably changed, and thereafter acetylating the treated materials.

---

**Photographic film comprising casein, cellulose esters and gelatin.** Frank Forster Renwick, assignor to Du Pont-Pathe Film Manufacturing Corp., Wilmington, Del. U. S. P. 1,680,635, 1,680,636; both Aug. 14, 1928.

"Non-static film having a layer of a protein, such as casein, and a cellulose ester backing.

1. A photographic film including a body layer comprising cellulose nitrate, and a layer comprising a cellulose ester and a protein. 9. A photographic film including a body layer comprising cellulose nitrate, and a layer comprising casein and gelatin together with a cellulose ester. 6. A photographic film including a body layer comprising cellulose nitrate, and casein.

---

**Esters of cellulose-xanthic acid.** Leon Lilienfeld, Vienna, Austria. U. S. P. 1,680,224; Aug. 7, 1928.

A special form of viscose (cellulose xanthate) is treated with di-ethyl sulfate or ethyl bromide or their equivalents, yielding the ethyl ester. Other examples recite dimethyl sulfate or methyliodide as the reagent. The reaction takes place practically under neutral conditions. The process as well as products are claimed.

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**Cellulose Ester Solvents, Plasticizers and Compositions. Use of di-isobutyl fumarate, dimethyl and diethyl maleiate.** Otto Drossbach and Otto Jordan, assignors to I. G. Farbenindustrie A.-G., Germany. U. S. P. 1,677,753; July 17, 1928.

Cellulose nitrate is made into a homogeneous mass in a kneading machine by means of alcohol and about 40 per cent its weight in furmaric acid di-isobutyl ester at from 60° to 70° C., in the manner usual in the celluloid industry. The mixture can be well rolled at 80° C. and after being pressed at 80° to 90° C., can be cut to beautiful, clear celluloid sheets. After drying, the finished celluloid is not different from that prepared with the aid of camphor; it can be torn at room temperature without exhibiting brittleness.

In a similar manner the esters of fumaric or maleic acid with other aliphatic or with hydroaromatic alcohols, for example the dimethyl, di-ethyl, di-propyl, di-amyl, di-hexyl or di-cyclohexyl esters can be employed for dissolving cellulose nitrate; generally a quantity of ester corresponding to between 35 and 50 per cent of the weight of the cellulose nitrate will be employed.

**Example 2.**

50 parts of collodion are dissolved in a mixture of 450 parts of ethylene glycol mono-ethyl ether, 475 parts of benzene and 25 parts of maleic acid di-ethyl ester. The lacquer so obtained forms bright, suple film coatings. Instead of maleic acid di-ethyl ester, other aliphatic or fumaric acid may be employed.

**Example 3.**

Ethyl celulose is kneaded with alcohol and about 75 per cent its weight of maleic acid di-methyl ester at an elevated temperature and converted into a plastic mass. Instead of the said ester, other esters of fumaric or maleic acid may be employed in about the same quantity.

---

**Molded Article of Celluloid, Plaster of Paris and fibrous webbing.** George L. Preble, assignor to Preble Box Toe Co., Lynn, Mass. U. S. P. 1,678,021; July 24, 1928.

Material for making molded articles comprising a fibrous sheet, plaster of Paris interspersed among the fibers thereof, and a matrix of cellulose compound in the interstices between said fibers and plaster of Paris.

Material for making molded articles comprising a fabric sheet, hydrated plaster of Paris interspersed among the fibers thereof, and a matrix of a cellulose ester in the interstices between said fibers and hydrated plaster of Paris.

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### Resinoids

**Resinoid product from oil of cassa and phenol.** James McIntosh, assignor to Diamond State Fibre Co. U. S. P. 1,679,322; July 31, 1928.

100 grams oil of cassia are mixed with 200 grams of phenol, using an acid as a catalyst. Two hours heating under a reflux condenser suffices to cause combination to take place. The excess phenol is distilled off in vacuo. A black resin results. "Hexa" is used to harden the resin. Claim 11: "The process which comprises heating together a phenolic body, an essential oil having an aldehyde base and a condensation reaction catalyst until there is formed a fusible, soluble condensation product, adding hexamethylenetetramine thereto, and further heating the same to form a hard, infusible, insoluble resin."

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**Phenol-Urea-Formaldehyde Resin suitable for casting.** Charles O. Terwilliger, Mt. Vernon, N. Y., assignor to Fritz V. Briesen, Trustee, N. Y. City. U. S. P. 1,678,024; July 24, 1928.

A method of making condensation products which comprises providing a solution containing urea, formaldehyde and a phenolic body, in which the ratio of 40% by weight aqueous formaldehyde to urea is less than 2.5 to 1.0, the amount of phenolic body being approximately 10% of the weight of urea, and heating the same to form a condensation product.

A condensation product comprising the product of the reaction of urea and formaldehyde in the ratio of 1 to about 1.9 parts of 40% by weight aqueous formaldehyde and a phenolic body, the said product being clear and transparent.

---

**Plastic Resin of Glycerol, phthalic anhydride and Furfural.** Courtney Conover, assignor to The Selden Co., Pittsburgh, Pa. U. S. P. 1,678,105; July 24, 1928.

Ninety-two parts of glycerol and 148 parts of phthalic anhydride are heated together. The temperature is allowed to rise slowly to 210° C., and is held at about that point for about one hour more or less, till tests of the batch show the product to be brittle and only slightly sticky when cold. The temperature is then lowered to about 140° C. and 48 parts of furfural are added to the batch. The mixture is stirred till homogeneous.

The product is a mobile, dark colored liquid at 130° C.

The following examples give approximate proportions of successful compositions:

1. 92 parts glycerin—148 parts phthalic anhydride—30 parts furfural.
2. 92 parts glycerin—184 parts phthalic anhydride—48 parts furfural.
3. 92 parts glycerin—184 parts phthalic anhydride—30 parts furfural.

Minor changes from the above quantities do not affect the product.

---

**Molding shellac articles hardened with a guanidine compound.** Elmer A. Daniels and Harry S. Snell; assignors to Western Electric Co. U. S. P. 1,673,803; June 19, 1928.

Shellac can be condensed or at least caused to combine with a guanidine such as diphenyl- or triphenylguanidine. The composition on heating to 270° F. becomes insoluble in alcohol. Both the shellac and the diphenylguanidine are dissolved in alcohol and mixed with wood flour and the mixture is dried, leaving a molding powder that molds at 2000 lbs. pressure and from 260-270° F. One of the claims calls for "A method of hardening a resinoups exudation, which consists in adding thereto a guanidine and subjecting the resulting mixture to heat and pressure." Further details, and other methods of attaining these results are contained in patents 1,673,804-1,673,808 published elsewhere in **Plastics.**

---

**Condensing Urea and Formaldehyde under Pressure.** Alphonse Gams and Gustav Widmer; assignors to Society of Chemical Industry. Basle, Switzerland. U. S. P. 1,674,199; June 19, 1928.

The initial condensation of urea with formaldehyde for the production of resinous bodies is carried out under pressure. For example 600 parts of urea are dissolved in 1645 parts of neutralized formaldehyde solution of 36.5 per cent strength and the solution is heated in an autoclave for 3-4 hours at 120° C. The product is clear and gelatinizes like a gum. Claim 1.

1. A process for the manufacture of condensation products from urea and formaldehyde, wherein the condensation is conducted under a more than atmospheric pressure.

---

**Light colored "C" stage phenol resins.** Leonhard Deutsch and Isak Thorn, assignors to the Selden Co., Pittsburgh, Pa. U. S. P. 1,678,107; July 24, 1928.

Boric acid is added to phenol formaldehyde mixtures, followed by alkaline carbonates to effect condensation.

**Example 1.**

1 kilogram of phenol and 1 kilogram of formaldehyde are brought to reaction with 10 to 20 grammes of sodium carbonate, now 20 to 50 grammes of borax are added and the whole is cooled for half an hour, 15 to 50 grammes of glacial acetic acid are added and treated as above.

**Example 2.**

1 kilogram of phenol and 1 kilogram of formaldehyde as above are condensed with 10 to 20 grammes of sodium carbonate, 10 to 50 grammes of boric acid are added, the water is expelled and hardened as before.

---

**Hardening cast phenolic resins in molds open at top and bottom using liquid metal seal.** Leonard Deutsch and Isak Thorn; assignors to The Selden Co., Pittsburgh, Pa. U. S. P. 1,678,108; July 24, 1928.

In order to be able to remove the hardened resin from the box in which it was cast one employs a mold which is not closed at the bottom and through which may be caused to flow a liquid which does not mix with the mass to be hardened, does not affect its surface and is of a greater specific


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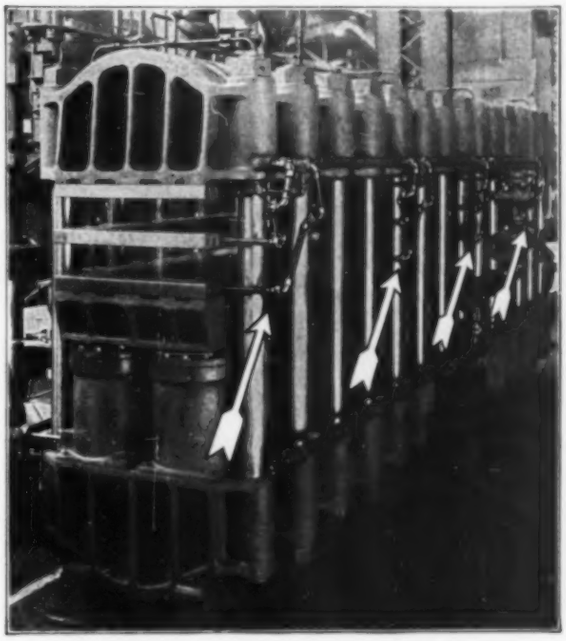

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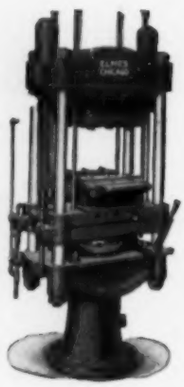

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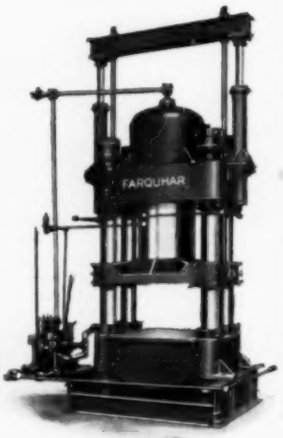

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gravity than the same. The liquid also acts as a heat-conductor and thus facilitates the maintaining of constant temperature and therefore considerably reduces the danger of the formation of bubbles owing to superheating as well as the danger of internal tensions (cracks, deformations) in consequence of local differences in temperature.

Salt solution can be used for this purpose, also an easily fusible metal-alloy may be employed, such as for instance Wood metal or Rose metal.

During the hardening, the covering mass may be allowed to solidify, in which case the separation from the reaction product will be far easier. As the mold is open at both top and bottom, the hardened cast-articles may be removed without difficulty.

---

**Xylenol Resins.** Gustave E. Landt, assignor to Diamond State Fibre Co., Bridgeport, Pa. U. S. P. 1,679,312; July 31, 1928.

2. The process of making a synthetic resin which comprises causing substantially pure xylenol to react with a compound having an aldehyde group to give an initial condensation product which is capable of being converted by further heating into a hard, infusible, insoluble resin.

## Miscellaneous Resinous Products

**Polymerization of coumarone and Indene to form resins.** Staurt P. Miller and Joseph B. Hill; assignors to The Barrett Co. U. S. P. 1,679,093; July 31, 1928.

Solvent naphtha and similar liquids containing cumarone and indene, which are convertible into "cumar" resins by polymerization, are emulsified with sulphuric acid in rapidly revolving emulsifying engines of special construction.

---

**Production of cumarone resins.** Wesley R. Gerges, assignor to The Barrett Co. U. S. P. 1,679,214; July 31, 1928.

Solvent naphtha containing coumarone and indene is emulsified with sulphuric acid and afterwards the emulsion is diluted with water whereby sludge separates. The upper layer of naphtha is washed with alkaline water, separated therefrom and distilled, yielding solvent naphtha in purified form and a residue of the desired light colored resin in the still. For instance: 7. The process which comprises treating solvents containing polymerizable constituents of the coumarone and indene classes with a polymerizing agent and, before all the polymerizable constituents have been polymerized, diluting the sludge so formed with a sufficient amount of non-neutralizing diluent to liberate the oil therein and cause the sludge to settle rapidly.

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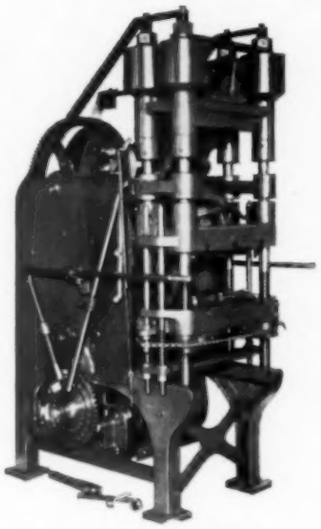

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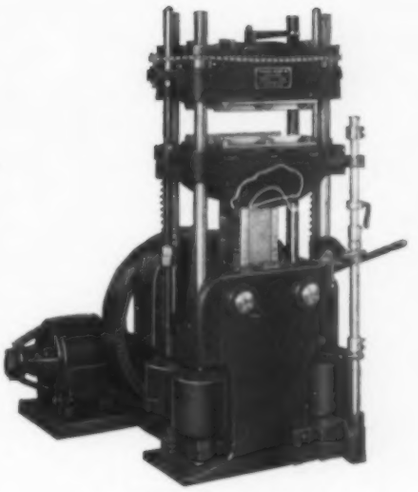

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## Cold Molding Resins

(*Continued from page 87*)

**C. Ellis, Patent 1,500,303, July 8, 1924.**

*Method of Making Condensation Product.*

A phenol or cresol is slightly acidulated with a concentrated acid such as hydrochloric or sulphuric and paraldehyde is gradually added, the absorption of the heat by conversion of the paraldehyde into acetaldehyde counteracting the evolution of heat due to the interaction of phenol and acetaldehyde. The product is allowed to stand, then heated and the acid neutralized. The resin may be dissolved in acetone and mixed with asbestos to form a molding composition. A variation is to dissolve the resin, add hexamethylenetetramine, impregnate wood flour therewith and grind the mixture with aluminum palmitate. Another variation is to add the acid to the paraldehyde instead of to the phenol.

**V. H. Turkington, Patent 1,503,392, July 29, 1924.**

*Article and Method of Cold Molding Same.*

Permanently fusible resin and hexamethylenetetramine or other hardening agent or a potentially reactive phenolic resin is mixed with furfural, benzaldehyde, hexoic aldehyde, isohexylaldehyde, manno-heptose, methyl furfural or other condensation product solvent of high boiling point or mixture of furfural and any one of the others. The liquid is then added to a filler such as asbestos or wood flour and well mixed in the cold. Coloring materials may also be added. Traces of water may be gotten rid of by means of calcium oxide. The furfural has the advantage of combining with the liberated ammonia to form furfuramide which under the influence of heat changes to furfurin.

**L. T. Richardson, Patent 1,508,124, Sept. 9, 1924.**

*Method of Making Articles.*

Phenol or cresol and an aqueous solution of formaldehyde are caused to react in the presence of hydrochloric acid by means of heat after which the heat is cut off and the reaction allowed to go on. Then the mass is thickened by heat, the water drained off and a fibrous filler such as abestos is added after cooling the binder. The mass is dried, ground to a suitable size and if necessary moistened with a solvent such as alcohol or softened by the means of heat. The mixture is introduced into molds and molded under great pressure at room or slightly higher temperature. The article is removed from the mold and subjected to a heat treatment under either a gradually increasing temperature or a temperature which is elevated from time to time until the desired maximum is reached.

The condensation product, may be made by combining cresol, concentrated hydrochloric acid and formaldehyde to produce incomplete condensation, then cooling and adding hexamethylenetethamine. It is possible to separately mix the condensation product and the hexa with the filler and to use solid hexa. Reaction can be more readily controlled if cresol and acid are heated alone

# Essential Books

**Plastics and Molded Electrical Insulation.**

Emile Hemming. 313 pages. Illustrated. $6.00.

Very special care has been taken in the preparation of the chapter on molded insulation. Contains hundreds of references to plastic and composition products and their utilization in industry.

* *

**Casein and Its Industrial Applications.**

Edwin Sutermeister. 296 pp. Price $5.00. Illustrated. 1927.

Eleven authorities, many of them specialists in this field, have contributed to this volume. "Casein in Plastics" is from the pen of Dr. Geo. H. Brother.

* *

**The Chemistry of the Natural and Synthetic Resins.**

T. Hedley Barry, Alan A. Drummond and R. S. Morrell. 196 pp. Price $5.50. 1926.

The work of three English chemists, who are recognized authorities on this subject, one of vital interest to the Plastics Industries.

**Celluloid.**

Its raw material, manufacture, properties and uses.
Dr. Fr. Bockmann. 188 pages. 69 illustrations. $3.50.

In this book, the raw product, cellulose and its properties are thoroughly described. Other raw materials and methods of rendering them more plastic also receive attention.

* *

**Synthetic Resins and their Plastics.**

Carleton Ellis. 514 pages, illustrated. $8.00.

The book will serve as a guide and prove a stimulus to the numerous investigators and practicioners in the field of artificial resins. The section on plastic molding is an especially valuable feature.

* *

**Pyroxylin Enamels and Lacquers.**

Samuel P. Wilson. 213 pages. Illustrated. $3.50.

An authoritative work dealing with the materials and manufacture of pyroxylin solutions and with their application in the industry.

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to the reacting temperature and the formaldehyde then added bit by bit. The acid may be mixed, if desired, with the formaldehyde instead of the cresol.

**H. M. Weber, Patent 1,536,253, May 5, 1925.**

*Prematurely Cured Plastic Material and Process of Making the Same.*

Invention is directed to making very sensitive composition, preforming the composition in the cold and transferring the roughly shaped article to a hot mold wherein the curing is completed. Several examples of compositions are given:—coal tar acids are mixed and boiled with a formaldehyde and magnesium oxide mixture. Then nigrosine is added and wood flour impregnated with the solution after which the mass is dried in a vacuum. Metaparacresol may be used instead of the tar acids, dolmitic hydrated lime instead of the magnesium oxide and lampblack incorporated at the same time as the wood flour.

**F. P. Brock, Patent 1,537,454, May 12, 1925.**

*Abrasive Implements and Method of Making Same.*

Refers to Patent 942,808 over which this patent is an improvement.

Properly sized abrasive grain such as carborundum is thoroughly mixed with a potentially reactive phenolic resin, preferably in powder form. mobile methylene groups, or the reactive resin resulting from the initial reaction of a phenol upon formadehyde or other body containing mobile methylene groups, or the equivalent mixture of a permanently fusible resin with a sufficient proportion of a hardening agent such as hexamethylenetetramine. If desired, a few drops of phenol, cresol, creosote oil or even of water may be introduced in order to prevent segregation in the mass. After thorough mixing a substance serving the triple function of a solvent for the resin, a plasticizer for the mass and a supplemental hardener in the final curing step is added. As such substance furfural may be used. The furfural may be substituted in whole or in hyde, phenylacetaldehyde, tetrahyhyde, isohexyl, aldehyde, mannoheptose, methylfurfural, nitro-benzaldehyde, phenylacetaldehyde, tetrahydro-benzaldehyde or other reactive aldehyde boiling above 100° C. The mass is preferably cold-molded and then baked in an oven and allowed to cool slowly.

The product is an abrasive wheel.

**C. Ellis, Patent 1,541,336, June 9, 1925.**

*Cold-Molded Product and Method of Making Same.*

Invention is directed to heating rosin, phthalic anhydride and glycerol until they react to form resin, dissolving the latter in volatile solvent, incorporating tung oil and/or nitrocellulose, admixing with an asbestos, cold-molding and finally baking.

It is incidentally stated that acetone-formaldehyde, furfural-aniline furfural-phenol-acetone and phenol-formaldehyde resins may also be incorporated.

**L. T. Frederick, Patent 1,636,411, July 19, 1927.**

*Gear Blank and Method of Making Same.*

Scrap fibrous material containing is chopped or ground up, moistened with either solvent for uncured Bakelite or with liquid Bakelite and preformed in cold press so as not to cure the Bakelite and then dried. The preformed blank is then inspected and if satisfactory is placed into hot press either alone or with rings, disks or sectors for producing the desired form of blank. If the gear is to have a thickened rim, the mold is formed with a recess into which an impregnated fabric disk is laid. Several rings or ring sectors are placed thereupon to form the thickened rim and the preformed body portion is placed thereon after which the complementary rings and disk are placed on the other side of the performed body and the assembly cured.

**E. J. P. C. DeJarny, Patent 1,643,447, Sept. 27, 1927.**

*Method of Making Condensation Product.*

Invention is directed to condensing a phenol such as raw phenol, meta paracresol and/or tricresol and formaldehyde in the presence of an alkaline earth chloride such as calcium chloride, differing from Patent 942699 to Baekeland in that the chloride is present in more than 15% of the formaldehyde and from French Patent 563,777 in that more formaldehyde is used. The chloride may be dissolved in the formaldehyde and the solution added to phenol and boiled. The reaction can be stopped at the saliretine or resitol stages while the resin is still fusible and cold kneadable, during which stages filling materials such as asbestos, sawdust or sawdust and crushed glass may be added. The resin may be incorporated with either a soft or hard rubber composition.

The molding may be preformed in the cold and the article heated with or without mold. The product may be used for insulation or substitute for Bakelite, galalith or ebonites.

**C. Ellis, Patent 1,645,693, Oct. 18, 1927.**

*Cold Molding Composition and Method of Making Same.*

It is stated that ortho cresol on account of its low activity has not been used commercially in the manufacture of phenolic condensation products, although ortho cresol formaldehyde resin has been used as plasticizer in hot molding compositions.

Commercial ortho cresol or the phenoloid substances present in tar obtained by low temperature carbonization is heated with paraform or formaldehyde and caustic soda on condenser or in autoclave. The resin is dissolved in acetone, and mixed with a drying oil such as tung oil or linseed oil and filler such as wood flour or asbestos fibre or powder. The mixture is preferably dried in air, ground, molded in the cold and baked under a gradually rising temperature. The drying oil and the volatile solvent are for the purpose of tempering the composition.

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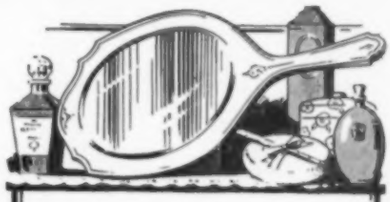

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## Role of Solvents and Plasticizers

(*Continued from page 81*)

lulose as the length of the alkyl chain increases.

The effect of constitution upon the light fastness is particularly interesting in some cases. In the toluene sulfonamide group, the presence of a phenyl substituent in the sulfonamide nitrogen decreases the light fastness, while an alkyl group increases it. For example, in the series:

*para*—Toluene sulfamilide
*para*—Benzyl sulfonamide
*para*—Toluene menthyl sulfonamide

The fastness to light is in the ratio 1:7:40. This shows clearly that the phenyl group directly attached to the amide nitrogen decreases the fastness to light; removing the phenyl group by a $CH_2$ gives a product which is intermediate between the anilide and methyl amide, which is quite stable to light.

The volume of research work going on in this one branch of the field of plastics is increasing.

Many negative results are to be expected but a proper placing of the sulfonamide products in the industriel applications of cellulose compounds may be expected to follow.

## PYROXYLIN AS IMITATIVE MATERIAL

(*Continued from page 71*)

flow of the stock in its movement to fill up the blank spaces left in the mold. It is clear that the larger the rolls are made the greater the flow and the coarser the result, and the reverse.

### Carbonate of Strontium as a Pigment

The Edson patent 309,831 describes the following process: The pyroxylin is prepared without pigment or coloring matter, and kept as clear and white as possible, and when in dough like state it is rolled into sheets, say one-sixteenth of an inch thick, more or less. Another batch of pyroxylin is prepared, but containing carbonate of strontia, say in the proportion of one part to two hundred parts of pyroxylin and this is also rolled out into thin sheets. From these sheets, placed alternately one above the other, a block is built up, according to the style or grain desired. A transparent or opaque sheet is laid the one on the other and rolled upon a mandrel, or without, until a roll of some size is accumulated. Then the roll is taken, twisted, and passed through rolls, rolled down into a slab suitable for cutting, say, knife-handles, or any article it is desired to produce; or the sheets may be accumulated on a large roll and cut off from it in strips and the strips slightly twisted and rolled down into slabs; or many other similar methods may be resorted to.

### The Use of Aniline Yellow

The process of patent 320,884 dated June 23, 1885 secures a homogeneous compound of like density throughout, the surface only of the rolled sheets being tinted with a slight stain of color, the result being a closer imitation of natural ivory, the manipulation more facile, and with the ingredients used as hereinafter described a translucency peculiar to natural ivory is obtained.

The ingredients preferred and their proportions are: of soluble pyroxylin, about ten parts; of camphor, from four to five parts; of precipitated sulphate barytes, about three parts; oxid of zinc, either precipitated or sublimed, one part. Better results are obtained by reducing these ingredients to a fine state of division, rendering them perfectly dry, and thoroughly mixing them together, and then adding either of the following solvents or a mixture of any of them, viz: ethyl alcohol, methyl alcohol, or methylated spirits, say, about six parts, the solvent being added to the mixture of pyroxylin and neutral matters mentioned above. The agglutinated mass is subjected to heat and pressure effected between a pair of rolls in the usual manner so as to reduce the material into sheets, the thickness of which may vary from about one thirty-second to one-sixteenth of an inch. Alternate sheets are then dipped either into a very dilute solution of aniline yellow of a tint that will imitate the grain of the natural tusk, or the surface of each sheet or of each alternate sheet is then painted over with a very dilute wash of aniline yellow, one part of the aniline to one thousand parts of alcohol being ample. The sheets are now bundled up in layers and submitted to pressure until a perfect weld of each layer to the next is effected. These sheets thus welded together are then ready for manufacturing purposes, and can be reduced to such forms as may be required by any method known to the art.

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## TECHNICAL ABSTRACTS

**Antistatic film coated with an abietic acid ester.** Paul C. Seel, assignor to Eastman Kodak Co., U. S. P. 1,684,042; Oct. 9, 1928.

The glyceryl ester of abietic acid, dissolved in acetone, is used to coat the back of a photographic film to prevent development of an electrical charge (static) thereon.

**Antistatic film coted with a *p*-toluene sulfonamide-formaldehyde resin.** Paul C. Seel, assignor to Eastman Kodak Co., Rochester, N. Y. U. S. P. 1,687,041; Oct. 9, 1928.

3 parts of para-toluene sulfonamide-formaldehyde resin are dissolved in 97 parts parts of acetone, and this solution is sprayed on the back of a photographic film to prevent static.

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# MOLDED PRODUCTS

Devoted to the purchase, further use and merchandising of all manner of molded parts

**Vol. 3** **FEBRUARY, 1929** **No. 2**


# Molded Dishes and Household Fixtures

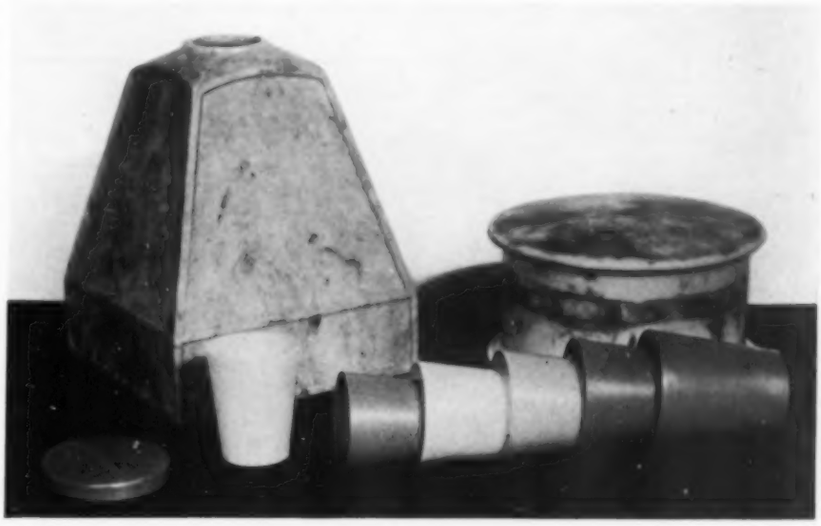
## Beetle Molding Powder to be manufactured in America can be molded in pure white and colors

THE American Cyanamid Company has signed an agreement with the British Cyanides Company, which provides that the former Company will proceed to create a subsidiary corporation for the manufacture of Beetle Moulding Powder in the United States.

Beetle is the first practical and successful urea-thiourea-formaldehyde moulding powder. It has been in successful commercial use in Great Britian for nearly two years, and arrangements for its manufacture in Germany were recently established. The special feature of the powder, which gives it a unique usefulness in certain fields is the fact that it can be made in pure white, as well as light and translucent colors.

One moulder, the Kurz-Kasch Company, of Dayton, has imported Beetle for about a year, and has used it successfully. Most of the output, consisting of drinking cups and similar items, has been sold through Marshall Field & Company, of Chicago. The Northern Industrial Chemical Company, of Boston, have an experimental stock of the powder and have produced a number of attractive mouldings of translucent lamp shades, bouillon cups, switch plates, and other items.

The field of usefulness which has been found for Beetle in England comprises, as might be expected, a great diversity of objects,—one of the important fields being steamship fittings. The P. & O. Steamship Lines have used Beetle fittings in the Tropics for as long as two years; the purpose being to get rid of the endless polishing of brass and nickel on items like door handles and escutcheons,

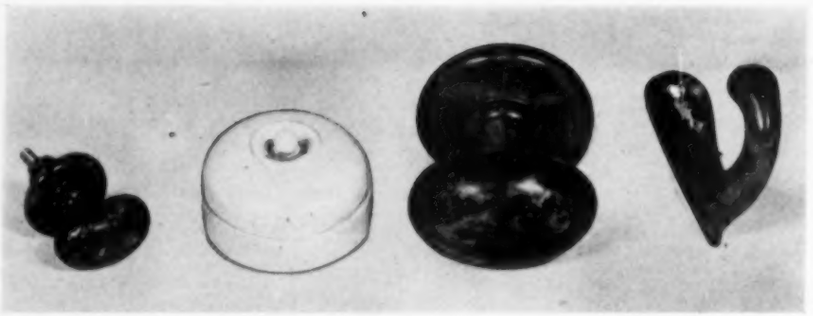


Translucent lamp shade, in bright blue, mottled powder box, and a set of colored liquor glasses molded of Beetle.

drawer pulls, plumbing fittings, etc. One moulding plant is running continuously to capacity business on steamship items alone.

Another British moulder has built up a very successful and growing business in table ware of Beetle, some of which has been illustrated in past issues of "Plastics." The leading item has been coffee sets, sold through the great London department stores.

Beetle is suited also to automobile hardware, plumbing fixtures and electrical work. It has about the same strength as the phenol-formaldehyde moulding powders, but is more elastic and can be made in very thin shapes. It can also be moulded over metal in a thin layer, or to hold metal inserts. It has greater depth of gloss than the phenol-formaldehyde mouldings, is translucent, and, in the natural color, is cream white.



The door knobs and hanger are made of brass with a veneering of Beetle molded on them. The base of the switch is porcelain while the top is white Beetle. The molded Beetle is actually whiter than the porcelain.

It is expected that American-made Beetle will be available about May 1929.

Although Beetle is moulded in much the same way as Bakelite and Durez, special precautions have to be taken to exclude dust from all processes and to avoid staining of moulds; and, accordingly, it cannot be used in the typical moulding establishment without some special adjustment of processes and management.

Attractively colored dishes molded of Beetle powder.

# Resinoids to be Used for Tank Lining in Chemical Plants

THE ever-increasing growth of the hydrometallurgical industries in the United Kingdom and Western Europe generally is giving a stimulus to the construction of plant on a large scale to resist hydrochloric acid and its solutions. Price forbids the use of the old stone tanks, ebonite lining, glass and earthenware. Rubber lining for foodstuffs is being tried, but care has to be taken to avoid contamination from arsenic, copper, iron and lead. Enamelware has long been known, but it is only recently that a satisfactory acid-resisting enamel has been applied to steel. Formerly only cast iron could be enamelled satisfactorily. Glass-lined vessels also are being supplied, chiefly for the transport of milk, but these do not resist the strong mineral acids.

It is to resinoids that one must look for new developments in this direction. Bakelite has remarkable acid-resisting properties, but heretofore not much use has been made of it for chemical plant. Recently a substance known as Haveg has been put on the market. This consists of bakelite and asbestos compressed into a mold and baked hard. It is rather costly, but for stirrers and special fittings for tanks and presses its longer life makes an undoubted appeal. Prodorite, a compound of pitch and cement, makes excellent floors, but is not so well suited for tanks except where the liquids to be handled are cold. Silica, despite its defects, has a big field. No other substance has so wide a range of acid resistance coupled with ability to resist high temperatures. It will not stand shock, however.

The transport of acids of all kinds is calling forth engineering of a new type and will mean the development of new plastic lining compounds.

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## Generic Name for Molded Products to be Chosen

THE NEMA Name Contest, sponsored by the Molded Insulation Section of the National Electrical Manufacturers Association, to obtain a generic name for molded products, closed recently with a total of 521 submittals.

The returns were received from contestants all over the country and the number was such that the Molded Insulation Section will probably receive a highly satisfactory name to be identified with all molded products. A prize of $250 has been offered for the best name.

The names submitted are now being considered by members of the Section and an announcement of the winner will be made by the Association within a short time.

# Combination Pencil and Calculator Molded of Resinoid

AN ingenious device of two-fold interest to readers of Molded Products has recently been put on the market. It is a combination slide rule and refillable pencil which besides being an interesting example of molding can also serve as a useful instrument to all manufacturers who must at times make rapid but accurate calculations.

The multi-vider as this novel pencil is called multiplies and divides. Hence its name. It is in addition a high grade automatic pencil with very original improvements in the pencil mechanism.

The body of the pencil is molded of Bakelite and is made in two parts which are arranged to slide on rails set in the molded parts. The slides are shown open in the center illustration. Each slide carries an accurate logarithmic scale as in the ordinary slide rule.

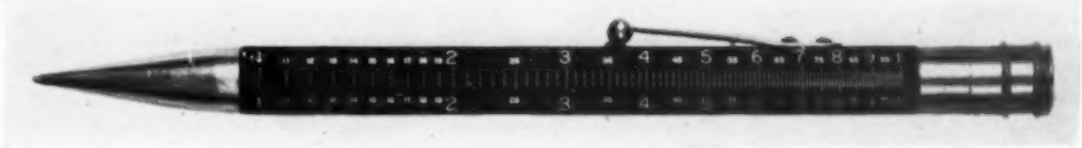
The multi-vider can be used easily without a knowledge of the mathematical principles which govern its operation. These principles however are very simple. Every number has a certain exponential function called a logarithm. In multiplying two numbers the logarithms are added.

Since the scale on the pencil is a scale of logarithms, to multiply two numbers you merely add the two corresponding distances on the scale. For instance in multiplying 2.10 by 3.65, the number 1 on one scale is lined up with 2.10 on the other. Then under the number 3.65 of the first scale, the second scale will show the solution to the problem.

In dividing the logarithms are subtracted. That is to say the logarithm of the divisor is subtracted from that of the dividend. So in dividing 2.10 by 0.4, the division corresponding to 0.4 on one scale is aligned with 2.10 on the other. Then the quotient will be found on the second scale under the number 1 of the first scale.

The operation of the multi-vider is, after a little practice, very easy. Although it was placed on the market but recently, it has already been sold in large quantities. Business men and engineers have found in it a very valuable time saving device. The calculations performed on it are accurate to three significant figures. It is not a novelty but a scientific instrument of the highest grade. At the same time it is so compact that it can be carried in the pocket like any other pencil.

It is manufactured by the Ruxton Multi-Vider Corp., New York City.



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**Japanese Boycott Causes China To Enter Celluloid Industry**

AS a result of the boycott movement, Japanese celluloid articles are no longer popular in China, and a group of Chinese capitalists recently opened a factory at Rue Galle, French Settlement, Shanghai, known as the Ta Chung Hwa Celluloid Factory, manufacturing some of the first Chinese-made celluloid articles. The plant, started last summer, is as yet rather inadequately equipped, and, for the present, its output is confined to toys and small articles for personal use. The raw materials are imported chiefly from Germany and Switzerland. Between 50 and 60 hands are employed and present production amounts to several hundred dozens of small articles. The sales are brisk and the factory is already contemplating extension of its working scope by installing new machinery. At present the products comprise toilet soap cases, cigarette cases, ping-pong balls, and a wide range of toys. The factory also accepts large orders for toothbrush and umbrella handles. All the factory's products are being marketed under the "Elephant Head" brand.

# Improvements In Non-Shatterable Glass

## Some facts about developments of very thin laminated glass.

*The manufacture of laminated safety glass required unusual improvements in the production of thin plate glass and the preparation of a homogeneous and transparent adhesive to cement the pyroxylin to the glass sheets.*

EARLY this year five hundred automotive engineers, executives of safety councils and journalists were asked to vote on seven innovations proposed for motor cars. Which one did they consider most essential? Non-shatterable glass led the field; in fact, it received almost as many votes as the next three innovations together—automatic chassis lubrication, light control on steering wheels, and vibration dampeners.

Automobiles today are wonderfully efficient machines, with high-speed motors, four-wheel brakes, clear-vision bodies and almost everything else to give a motorist riding comfort and a feeling of security so far as the operation of his car is concerned. But the joy of driving these days is lessened considerably because of traffic hazards and the ever-present chance of accidents on the highways.

Plate-glass windshields and the windows of closed cars are essential parts of automobiles for pleasure use. Also, glass is fragile. Millions of people drive at express speed—and not always carefully—in what might be termed glass boxes on rubber-tired wheels. No wonder smash-ups occur. No wonder "cut by flying glass" is a familiar headline in the newspapers. And no wonder non-shatterable glass is considered the most necessary and desirable innovation in the automobile industry today.

Now what is non-shatterable glass? The reader will understand best by analogy. Think of a cheese sandwich. Instead of two pieces of bread, think of two panes of thin plate glass. Instead of a slice of cheese, think of a sheet of transparent pyroxylin plastic. Instead of butter, think of a colorless liquid with adhesive properties. Make a sandwich of these materials and you have it—all except the process of binding these components together. That is done by heat and hydraulic pressure, and will be referred to later on.

This glass is stronger than ordinary glass of the same thickness, and you will readily understand why when you consider that glass is a mineral substance—hard, brittle and easily broken by severe shocks or heavy impact. Pyroxylin is of vegetable origin; it is chemically transformed cotton—not so hard as glass, but incredibly tough and flexible and almost unbreakable. By combining two sheets of plate glass with one of Pyroxylin, the resulting product is unusually strong and resilient. It is true the glass on one or both sides may crack under a heavy impact, but a crack in one sheet of glass rarely ever coincides exactly with one on the other side. The glass cannot break, nor can it shatter or fly, because the Pyroxylin binder holds it together.

The discovery that a sheet of pyroxylin plastic cemented firmly between two pieces of glass makes a non-shatterable product is by no means a new one. As a matter of fact the original patents taken out on this idea have expired.

Plant production of safety glass for miscellaneous uses has been under way for more than fifteen years. Notably during the World War large quantities of it were produced for gas-mask lenses, windshields for military automobiles and airplanes used in France. Eye protection was the big consideration in that emergency. Appearance was not the factor it is today. Ever since the war numerous efforts have been made by several companies to develop an extra fine quality of non-shatterable glass for use in the automotive industry. Obviously, glass for this use must be of a quality far superior to that for miscellaneous uses of a less exacting nature. It must have an exceptionally fine appearance at the outset, and must maintain it under all conditions of climate and exposure at least during the life of the car.

### Special Grade of Pyroxylin

Stability, therefore, presented another major problem that had to be worked out in collaboration with the makers of plate glass, and years more were spent finding out whether the product would stand the test of time and the agencies of deterioration. Assuming that the life of a car is five years, it will be readily understood why thousands of exposure samples had to be tested for years to prove that the product would maintain a satisfactory appearance. Many accelerated aging tests were conducted in laboratories to approximate the exposures that would normally occur in years of strong sunlight, and this work was supplemented by exposure

tests made in the vicinity of New York City; in the deserts of Arizona; in the Dry Tortugas Islands in the Gulf of Mexico; in Colorado on mountains more than 10,000 feet above sea level; in Kansas City, and several other places. In these tests, pyroxylin plastics made from various kinds of cellulose, purified by various methods, stabilized with various materials, and colloided with various plasticizers in a number of concentrations were tried out to determine which combination was best.

In these tests, it was found that certain methods of adhering plate glass and Pyroxylin were advantageous and that certain kinds of cement possessed advantages over others. It was also found that the composition of the glass itself influenced the longevity of the Pyroxylin.

### Thin Plate Glass

But that does not tell the whole story. For equally important improvements had to be made in the manufacture of plate glass in order to adapt it for the purpose. Inasmuch as the average automobile will not accommodate glass exceeding 9/32 of an inch in thickness, it has been necessary to make very thin sheets of plate glass, so that when two of them are welded together in conjunction with a sheet of Pyroxylin, the finished product will not be more than the thickness prescribed. This has meant that a process of making polished glass 1/8 inch or less in thickness had to be developed. Under the old-time methods of manufacture this was impossible.

### Glass-Making Modernized

The method adopted is known as the "continuous process." At one end of the factory there is a huge tank of molten glass into one end of which are introduced the raw ingredients. Out of the other end is continually drawn a ribbon of molten "metal." It flows between and on to ever-moving rollers which transfer the glowing sheet into the annealing oven. In so passing through at continually reducing temperatures the glass eventually comes out cool enough to be handled. Next, it is cut into uniform lengths and placed upon moving tables, where, after having been properly secured, it starts down a long line of revolving disks which grind the glass down to a plane surface. After grinding, the tables proceed to the polishers where another series of revolving disks polish the glass until it is given the beautiful surface known to every one. Following this operation the glass is turned over and the other side is treated in the same manner.

In the rough state the glass is approximately 3/16 inch in thickness, but the grinding and polishing process has reduced it to a beautiful, polished plate surface, from 1/8 to 7/64 inch in thickness. The production of thin plate glass by the method outlined marks a great forward stride in glass manufacturing.

After the glass is removed from the table it is washed and sent to the examining room. Here the defective sections are cut out and the selected glass is cut to pattern and sent to an adjoining factory where safety glass is made.

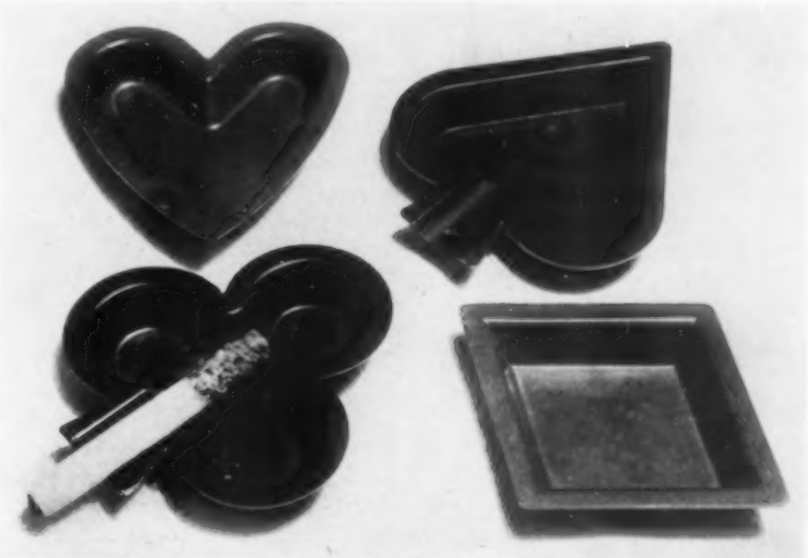
Upon entering this plant one is immediately impressed by its cleanliness. Every precaution is taken to eliminate dust and other impurities from the air and to prevent dirt from settling on the glass and Pyroxylin before they are welded into a solid piece of safety glass. The floors are kept immaculate by means of vacuum cleaners. In some departments even the air is washed before it is introduced into the room. The operators are clothed in white overalls. They wear white caps—and gloves. The place looks more like a dairy than a glass plant.

### How Safety Glass is Made

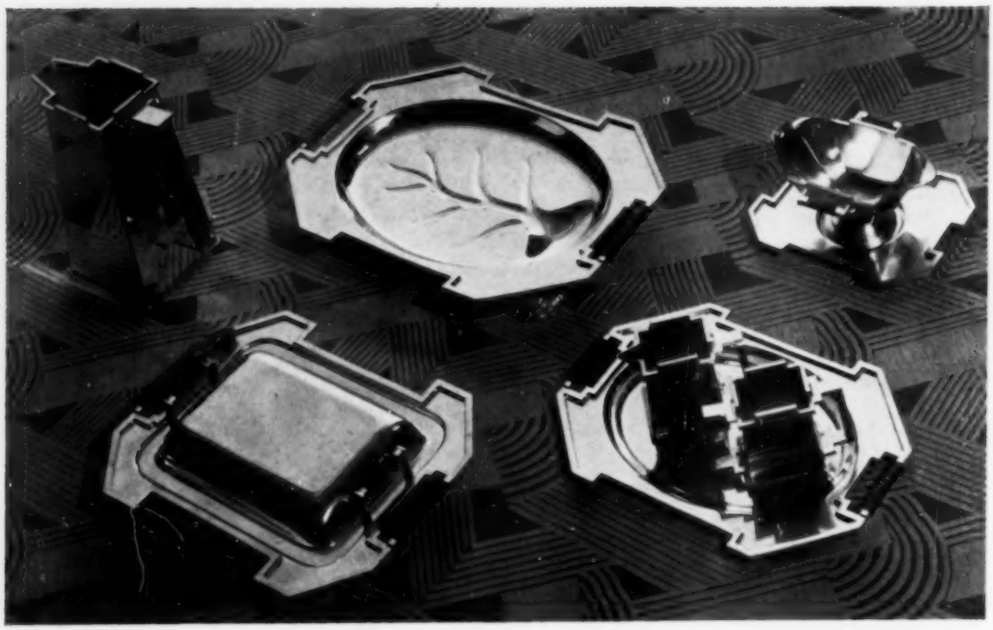
Two sheets of glass, cut to pattern, are washed thoroughly with pure water, and when entirely dry one surface of each plate is sprayed with a thin coating of the binding agent. Next, a sheet of Pyroxylin, also thoroughly cleaned, is placed between the two pieces of glass, making the "sandwich" previously referred to. It is of course necessary to bind the components together very securely to make a solid product, and this is accomplished by the use of special equipment, and the application of heat and hydraulic pressure. That, briefly, explains the method of making safety glass, which is as transparent as a solid piece of plate glass, and just as good looking with its fine polished surfaces.

(*Please turn to page 111*)

## Novel Molded Ash Trays



This handsome set of ash trays in red and black is an attractive and useful addition to the bridge set. They were molded by Allan & Hills.



# Molded Products in the Home

## Some examples of decorative molded articles for household use.

ELSEWHERE in this issue are shown some remarkable examples of molded articles for use in the private home, such as dishes, lamp shades and door knobs. The remarkable improvement in coloring plastic materials has made it possible to produce very attractive household articles by molding. Once the housewife discovers that the coloring on molded articles unlike those on other materials can never wear off molded products will become the standard medium of household furnishings.

To one in a position to observe the molding industry it has been very interesting to note the gradual displacement of wood, porcelain, glass and other materials by plastics. Today there is hardly an article made in these older media that could not just as well and sometimes better be manufactured out of resinoids or other plastics.

There are many properties of molded products which cannot be found elsewhere. Consider for instance the candlesticks shown in the illustration. They can be molded in any solid color or in mottled effects such as those illustrated. Due to the high elasticity of the material out of which they are molded these candlesticks are practically unbreakable under ordinary circumstances. They are in addition of very light weight. To produce an equally strong article of porcelain or glass it would have to be made in unusual thickness. The result would be a heavy and awkward candlestick, more expensive and less durable than a molded article.

With regard to the usual household articles into which a certain amount of artistic design enters it is no longer a case of unique and hand-made product against multiple production.

Very handsomely executed articles have long been manufactured on large scale and have met with very large and appreciative markets. Molded articles

are no more standardized than porcelain, glass, wood or other materials out of which products are manufactured in large numbers in standard designs.

On the other hand molding materials afford greater flexibility in design. The strength and elasticity of molded products makes it possible to execute delicate and graceful designs in that medium. Examples of such ornamental but nevertheless useful products molded of resinoids or casein have been frequently shown in the pages of **Molded Products.** They have demonstrated potentialities in molding which ten years ago were unthought of.

One very interesting development is illustrated in one of the accompanying illustrations. Lamp shades have recently been molded in very attractive styles out of casein and more recently out of Beetle powder. Now with the successful molding of a lamp base it is possible to assemble a completely molded lamp, including molded base, socket and shade.

The Manchester Molding Co. of Manchester, Vermont initiated this new application and has succeeded in manufacturing a molded table lamp which can be made at surprisingly low cost. This lamp as well as the candlesticks shown are molded of Celoron.

Another item of interest is the molded pitcher shown in the ilustration. This pitcher is molded in three parts which are assembled into a very handsome unit designed to contain a thermos bottle for ice water. It is molded of Bakelite.

An instance of the more decorative use of resinoids, is shown in the photograph of silverware which are provided with molded handles.

# Color Variety Or Color Harmony?

## The profusion of colors increases merchandising difficulties

*By R. E. Sandmeyer*
*President, R. E. Sandmeyer & Co.**

WHITHER are we drifting in making of the kitchen a colorful (and I mean "full") lounge for steaks, onions, eggs, soda crackers, and all-spice?

Refrigerators, stoves, kitchen cabinets, pots and pans, scrapers, stirrers, and flippers have followed the flapper and are capering about in the most amazing fashion and in the most amazing of porcelain, enamel and molded tulles.

Here's an excerpt from a recent advertisement:

. . . and now the crowning perfection of the kitchen of harmonized color. Now the full measure of the latest, smartest home enhancement to captivate the taste of refined households the country over. The gas range in color to synchronize with a ruling hue. . . .

The perfume copy writers have gone to work in the kitchen —following the "decorators" in a labor of love and harmony rather than biscuits and gravy. They don't have to live there anyway.

What is the thing all about?

### Emphasis On Ornament

To reduce to simple English it seems that the manufacturers of kitchen furniture have got to the point where they must (or think they must) have their goods arrayed so as to appeal to the aesthetic taste of the purchaser as well as to the utilitarian. Apparently they have gone as far as they can in the matter of workmanship and excellence of the product. The exigencies of competition have been such that the prices of most things used in the kitchen are down to the lowest possible limit. Efficient production and clever merchandising have united in producing a condition wherein high values may be offered at a comparatively small cost.

But no one manufacturer has a monopoly on these features. His merchandise is good and his prices somewhat near right. The same things can be said of his competitor. What then is he going to do to give his product a distinct individuality that will produce for it at least a shade of advantage in the never ending contest for consumer acceptance?

Here is where the color riot comes in. Somebody got the bright thought that instead of allowing sedate and natural colors to prevail he would call in the painter. This was not such a bad idea. And naturally enough other people took it up. The result is that today we have a great number of kitchen utilities each representing somebody's pet idea as to colors and each striving to outdo the other in the appeal to the eye. Inevitably, since each manufacturer is making and selling his own goods according to his own ideas, there are just about as many color combinations as there are articles. The woman buys this and buys that, only to find that her kitchen has become a veritable crazy quilt.

In other words, what ought to be a good and forceful selling idea is being misused in rather deplorable fashion. It seems to me that into this artistic puddle there should be hurled a stone of practicality.

Here is the stone:

Exactly what is it you have to sell? How does that check up with what you're trying to sell? And what is the best way to go about it?

More power to you in your efforts to banish the dullness and dreariness, the workshoppiness, of the kitchen; to make it a pleasanter place for the time that must be spent in it. But isn't the horse of your great group of customers headed the other way? Doesn't your market depend on "kitchen-minded" women, and isn't the kitchen-minded woman changing her mind? And aren't there a number of other difficulties that are being overlooked in the gold rush to the El Dorado of Color?

Color. Yes. That's one thing. But *colors*. That's a good many.

### Color Harmony

On the face of it, the color harmony that is the basis of sound color argument in selling is impossible without color standardization throughout the kitchen pieces. The woman who is besought to lighten her life by getting together a harmonious group of pieces can't do the job until manufacturers get together on colors so that she may "match" her stove with her refrigerator, with her kitchen cabinet, and so on.

The first thing, then, is settling the question of color; answering the question of "what color?" with the same answer in each type of kitchen equipment. So long as what one man says is and offers as kitchen "red" in several shades off what another says is kitchen "red," there can be no harmony to speak of. And harmony sales will likely be in proportion.

And here is another question: Is it really color you're trying to sell or harmony?

And if it is harmony, won't the housewife under these conditions say "you haven't got it"?

*Reprinted from Printers Ink.

Color and harmony are widely different, although they seem to be offered in the same package.

Color is now, and always will be, one man's fancy, another man's taste. You can do whatever you want with it, and if people like what you do they may buy it; if they don't they won't.

But harmony presupposes the agreement of color. No agreement of colors, no harmony. No harmony in manufacturing; no harmony in the home.

At the outset, then, manufacturers must secure harmony before they can sell it. And before they can secure it, they must decide what it is in terms of standardized, generally accepted and used colors. For instance, red, yellow, blue, green, must be the same in shade throughout the country, manufacturing, and merchandising, regardless of the intriguing names that may be applied to them to make them more fetching.

Having established color as the means of establishing harmony, what then? Is there a catch in it anywhere? Will a manufacturer feel that in adopting the standard colors he has increased his possibilities for sale or robbing himself of his individuality? Will he feel that in contributing to the common good, he has sacrificed more than he has gained? That his colors against the world would result in greater profit and success for himself?

### No Harmony For One Unless All Have It

For, you see, the adoption of color harmony is limiting in its nature. In order for one to have it, all mus have it. Otherwise there's no harmony for anyone. The thing each individual manufacturer is offering must harmonize with something else; his piece of kitchen equipment with other pieces of kitchen equipment.

And that changes the whole unit of sale. Harmony within the individual piece means nothing. Harmony must range over all the pieces; must include the whole. Which means that instead of each individual manufacturer selling individual pieces he has the job in common with other manufacturers of putting over whole harmonious kitchen schemes—the modern model kitchen—of which his product is but one piece. For the reason that until the model kitchen idea is put over, until people think of the kitchen in terms of a whole, harmonious unit, there can be little interest in pieces contributing to the harmonious whole. People naturally just don't care a darn about something that will contribute to something they don't or can't care a darn about.

The limiting effect of these factors is obvious. The manufacturer's individual piece becomes a part of a group including all the other pieces needed. He is, in effect at least, in the business of selling kitchens rather than the refrigerator, kitchen cabinet, or stove that is his product.

The deciding question accordingly becomes: Can the manufacturer secure more business by selling kitchen schemes, of which his product as an individual piece?

The answer to this naturally rests on this: Can the consumer be sold the kitchen as a whole with all that it involves in the way of expense, replacement, rearrangement, etc., to offset the advantage of color and harmony as readily as she can be sold this or that refrigerator,

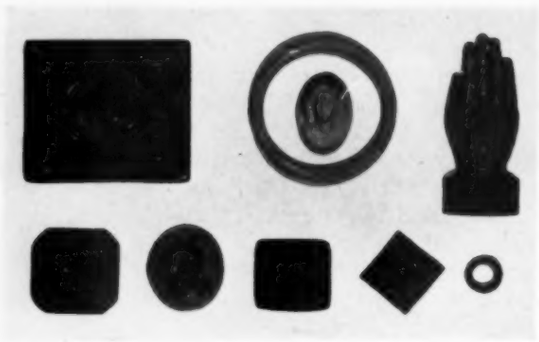
(*Please turn to page 112*)

An example of molded kitchenware handles. These are molded of Bakelite.

# Molded Casein Plastics

## Ornamental articles find an attractive and bright medium in molded casein

FEW people who use molded materials are familiar with molded casein. Casein plastics have for a long time been manufactured only in sheets, rods and tubes which had to be machined. But since several years successful methods have been devised for molding casein plastics.



Some examples of Molded Casein Plastics.

One cannot stress too much the value of molded casein. As is well known casein plastics can be manufactured in unusually bright colors. In the past this great advantage has been offset by the expense of machining so that casein buttons and ornaments had to be limited to such shapes as could be manufactured by the usual machines.

The complex and attractive designs shown in the accompanying illustrations could not be made by the usual processes. Molding them out of resinoids robbed them of the brightness and variety of colors so characteristic of casein plastics. Manufacturers of buttons, clasps and millinery decorations were therefore obliged to choose between bright colors with simple and commonplace designs or attractive designs in dull and limited colors.

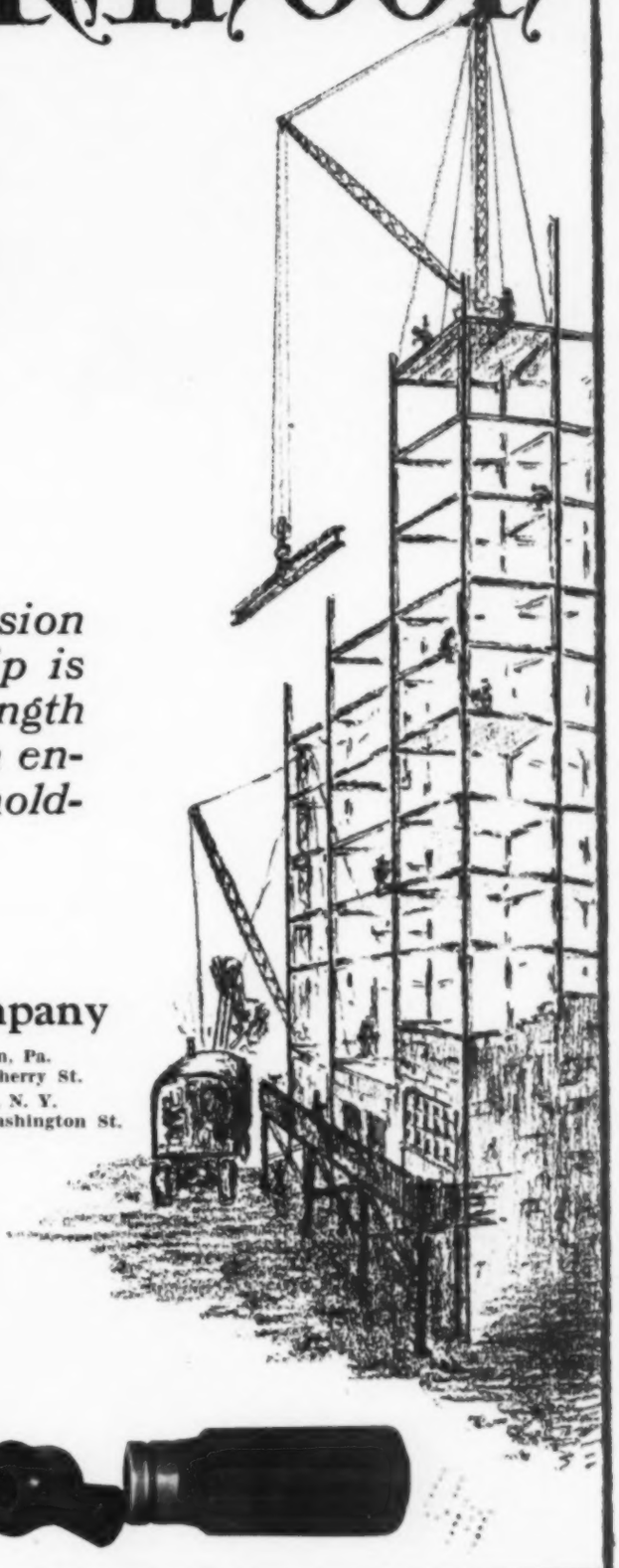
Developments in molding casein however have saved the manufacturer from the horns of this dilemma. It is now possible to combine a large variety of bright colors with the most delicate and involved designs.

It is possible for instance to reproduce exactly the finest examples of cameo art in colors that closely approximate the original. One of the "cameos" shown is made in two colors, the figure being given an opalescent hue while the background is of dark green.

The articles shown in the illustrations were molded by S. Milano.

SCRANTON

*THE beauty and precision of old craftsmanship is combined with the strength and durability of modern engineering in Scranton molded parts.*



## The Scranton Button Company

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645 Washington Blvd.

Detroit, Mich.
114 E. Lawn Avenue

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419 Cherry St.

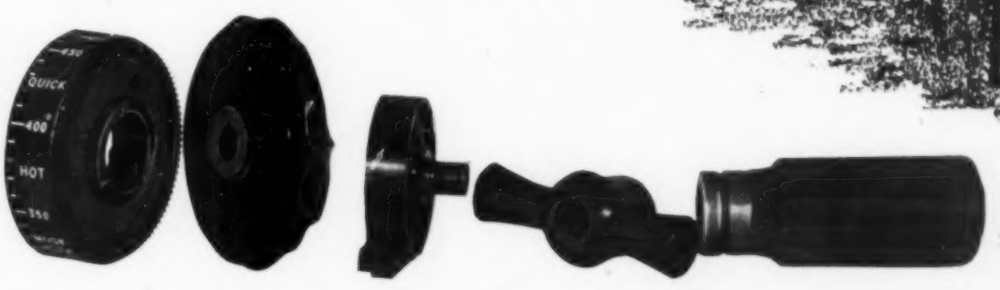
Cleveland, Ohio
4900 Euclid Bldg.

New York City
50 Union Square

Auburn, N. Y.
40 Washington St.

Main Plant
Scranton, Pa.

Branch Factories
Auburn, N. Y.
Framingham, Mass.




When writing The Scranton Button Company, please mention *Plastics*

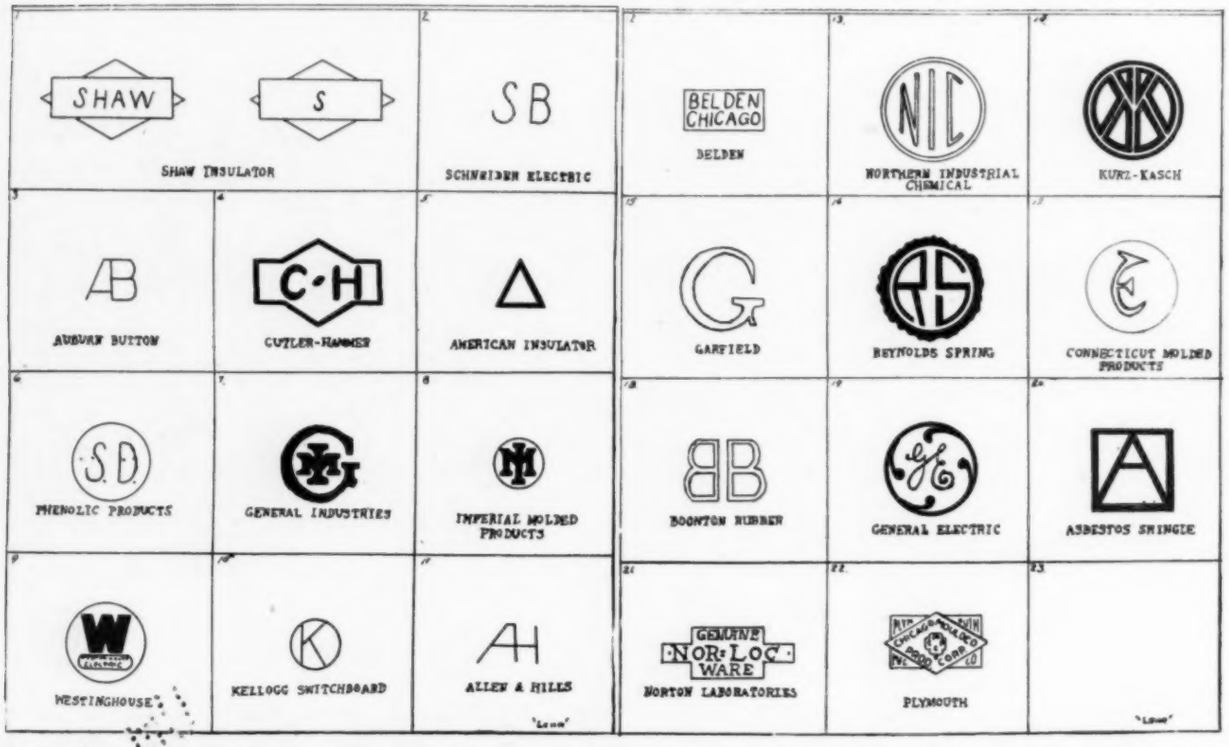
# British Industries Fair Opens With Novel Features

AS the opening of the British Industries Fair draws nearer (it is to held from February 18 to March 1) the prospects of its success grow greater. In the London section at the White City almost every branch of industry will be represented. The engineering section will be shown concurrently at Castle Bromwich, Birmingham. The Fair at the White City will be the largest of its kind ever organized in the United Kingdom. The original estimate of the accommodation required was 280,000 square feet. At last year's Fair 250,000 square feet was let to exhibitors. The total space booked this year is over 200,000 square feet. The demand for space at Birmingham was so great that the whole of the available area in the exhibition buildings, 200,720 square feet, was soon rented, and the authorities had to prepare rapidly an open-air section for the larger mechanical exhibits.

As regards buyers, the situation is equally satisfactory. The number of overseas firms which have informed the Department of Overseas Trade that they will be represented at the Fair is over six times as many as at the corresponding date last year, when only 110 concerns had accepted the invitation, although the actual number who attended was 1,958. At present close on 700 acceptances have been received, so that the overseas buyers attending the Fair should be considerably in excess of last year's number. No efforts have been spared to facilitate the work of the buyers. The catalog has classified indexes in nine languages. Special advance copies of this catalog have been sent to 10,000 business men in Europe, America, South Africa, and elsewhere, including all those buyers who have notified their intention to attend the Fair, in time to reach them before they depart for England. A corps of interpreters and a club room for the quiet transaction of business will be at the service of buyers, free of charge, at the Fair.

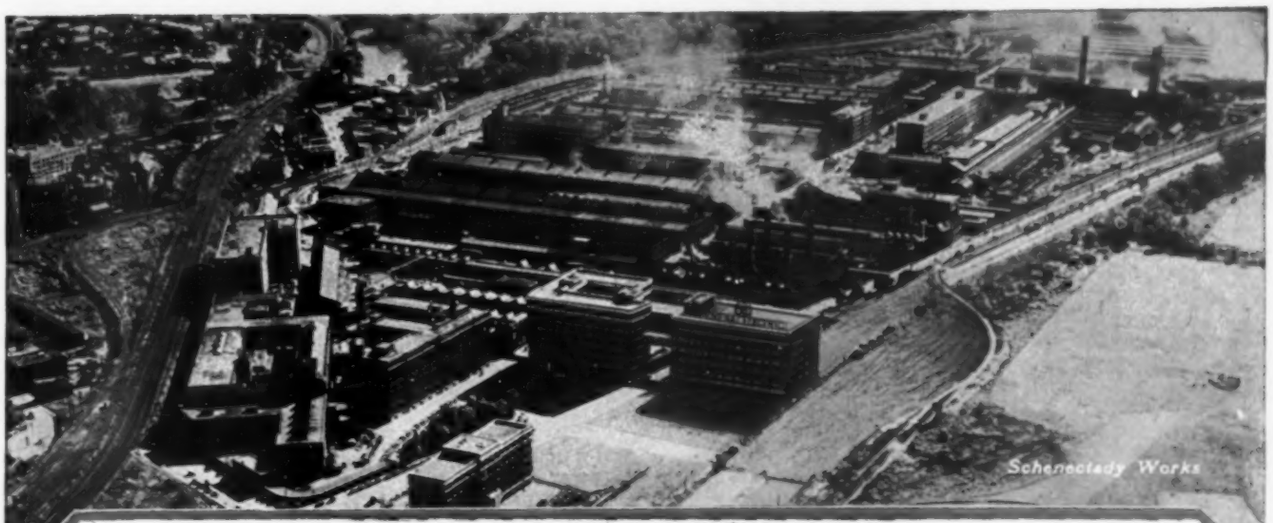
The number of manufacturing firms exhibiting at the London section this year is close on 1,300 while 700 are exhibiting at Birmingham. The Fair is divided into seventeen trade sections. Fifteen of the sections will be considerably more representative than they were last year. The exhibits of plastic and molded products will constitute a large portion of the chemical section.

## Trade Marks of Custom Molders




**At a recent meeting of the Molded Insulation Section of NEMA, it was unanimously agreed that the Association undertake the compilation and dissemination of sheets giving the watermark of each manufacturer of molded products who will furnish such information. As shown above, twenty-two watermarks have been received, both from member and non-member companies, and others are coming in. This NEMA service is one that should prove of considerable value to the molded products industry.**

# A dependable, permanent source of supply




In these mighty workshops of General Electric, millions of pieces of Textolite molded have been produced. And production to-day is greater than ever before.

Here is a supply available for decades; a responsible, comprehensive organization; a reliable source of highest-grade materials.

These plants are backed by the great resources of General Electric; by the famed research laboratories; and by unexcelled facilities for service.

For complete satisfaction in the use of custom-molded parts, specify G-E Textolite molded.

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# ALLEN & HILLS

*Molders*

AUBURN, N. Y.

"Where speed demands the utmost of accuracy and strength, Allen & Hills service is paramount.

The automotive industry with its exacting requirements has recognized Allen & Hill's products as standards of uniformity and precision.

*And the AH mark on a molded part is a symbol of this reputation."*

# British Safety Glass

"THE history, development, and methods employed in the manufacture of laminated glass," was the title of a paper read at a recent London meeting of the British Society of Glass Technology by W. R. Lyttleton, works director of the Triplex Safety Glass Co., Ltd. In his lecture Mr. Lyttleton said that the principle of securing a tough material between two hard and relatively brittle sheets had long been known for decreasing splintering under impact. Since the War many firms in the United States and the United Kingdom, a few in France and Germany, and one in Czechoslovakia, have manufactured this strengthened glass. The methods used vary considerably.

A layer of nitro-cellulose acetate, as transparent and free from cloud or any defects as possible, is securely fastened to glass sheets. To give long service an adhesive cement is employed to hold the layers together. In one method of manufacture, in order to obtain a perfectly clean surface on the glass plates, they are cleaned with rouge and washed in running water. When dry, the plates are evenly coated with a suitable gelatine solution, then this in turn is dried in warm filtered air. An enamel or varnish is applied to the dry gelatine.

Two prepared sheets of glass and a suitable sheet of celluloid are then placed in an alcohol bath at a definite temperature, and assembled as a "sandwich" with the celluloid in the center. The sandwich is then subjected to pressure in a hydraulic press, air bubbles and excess fluid being pressed outwards. In order to exclude moisture from the adhesives, the cellulose is "cut back" around the edges of the glass, and the space filled with pitch, bitumen, varnish or paint.

When writing Allen & Hills, please mention *Plastics*

The laminated glass is then ground, polished, and prepared for use in the usual ways. Cellulose acetate and nitrocellulose may discolor and become brittle, but use is now made of high-boiling-point solvents to overcome this difficulty.

## Allied Cellulose Acetate Interests In Europe

THE first statutory meeting of Acetate & Acetate Products (Foreign Rights), Ltd., was held in London recently, Sir Henry James Forde presiding. Sir Henry reviewed the position of the business for which the concern was formed. He said it owned in all countries, except the United States, the patents and processes which are today being worked by companies in the United Kingdom—namely, the Cellulose Acetate Silk Co., Ltd., the Non-Inflammable Film Co., Ltd., and Acetate Products Corporation, Ltd. A statement has already been circulated to the shareholders in the first company, showing that the directors have largely increased their holdings, that the assets of the company (without taking into consideration the value of their patents and processes) were well in excess of the liabilities, that the company was manufacturing in commercial quantities acetate of cellulose, which is the basis of all the products the group of companies is concerned in, of quality equal to the best produced, and at a price believed to be lower than that of any competitor.

Several eminent French and Belgian engineers have visited the factory of the Cellulose Acetate Silk Co., Ltd., and on the strength of their reports powerful industrialists in France and Belgium have joined the group, with which the company already has a provisional agreement, and very shortly Sir Henry hopes to be able to announce to the shareholders the actual formation of the French and Belgian companies to work the patents and process in those countries, and the names of the powerful interests who have allied themselves in their formation.

The chairman of the Acetate Products Corporation, Ltd., also recently at its statutory meeting gave the position of that corporation, showing the progress being made with its additional factory. It is believed that as soon as this firm's non-inflammable celluloid products are on the market they will entirely displace the inflammable articles sold today, and that the initial plant of four tons per day will have to be largely increased as soon as the machinery can be installed to meet the demand for the products.

Sir Henry refused to be drawn with regard to the developments of the Non-Inflammable Film Co., "as competitive interests are trying to obtain this information from us by every possible method."

The directors of this group of companies are all men of high commercial and financial standing, representing as chairmen, managing directors, and directors of other companies a combined capital of not less than £50,000,000 ($250,000,000). Sir Edward prophesied that the group had laid the foundations for a great industry which will give employment to many thousands.

Sir William Veno, a director, said that the cellulose acetate being manufactured at Lancaster by the Cellulose Acetate Silk Co. was regarded by experts to be the best in quality that could be produced at the present time. He expressed the belief that they were building up what would in time be a great world-wide organization based upon cellulose acetate for the manufacture of plastic goods that are now being made from celluloid. Celluloid, in his opinion, will have to be abandoned, and acetate of cellulose will take its place.


**These Trademarks**

TRADE ELECTROSE REG. U.S. PAT. OFF. & FOREIGN COUNTRIES

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Quality . . .
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Accuracy . . .
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**For parts that are outstanding examples of custom molding; for service that insures the most exacting attention to every detail of every job.**

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**General Insulate Co., Inc.**

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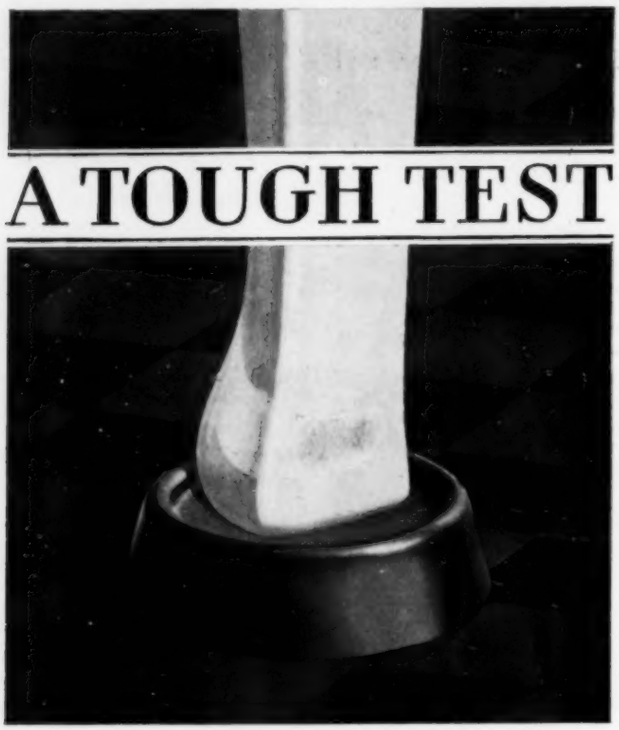
*If you are in the market for molded articles, we would like to send you representative pieces of our work. Your request will receive our immediate attention.*

When writing Insulation Mfg. Co. Inc., please mention *Plastics*



# A TOUGH TEST

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THESE CETEC stove rests have to stand years of hard use—the heavy weight of the stove—frequent wetness from floor scrubbing—sometimes knocks and bumps.

CETEC is ideal for use under such severe conditions. It is hard, dense, polished—will not stain, soften or deteriorate. It molds exactly to form, with metal inserts where necessary. No machining, drilling or fitting. Practically fireproof. Black, brown, or beautiful mottled effects.

Send us samples, blueprints or models of any parts. It is more than likely we can save you money.

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Give us full information about CETEC and its use in the following parts:

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Name _____

Address _____

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## Cellulose Acetate in Great Britain

PRESIDING at a general meeting of the newly-floated Acetate Products Corporation, Ltd., which has just been held in London, the chairman, Morris Greenhill, said that at the outset of the company's career all was well and the publicity created by its formation had resulted in a widespread inquiry and demand for its principal product—non-inflammable safety celluloid.

"Not only does this demand come from all parts of the United Kingdom," declared Mr. Greenhill, "but from many other countries, particularly America. As a result, I think I may say confidently that when the machinery now under construction for the manufacture of our raw materials is in full working order it will be taxed to its fullest capacity.

"We have entered into a contract with the Cellulose Acetate Silk Co., Ltd., for the supply of acetate of cellulose on favorable terms. That company is in a position to meet all our requirements as soon as our machinery is installed. As foreign cellulose acetate is, under the Safeguarding of Industries Act of 1921, subject to an import duty of 33⅓ per cent, we are fortunate in being able to assure domestic supplies. We have been extremely fortunate in obtaining the best possible technical advice and assistance in connection with the equipment of the works and the manufacture and disposal of our products, which, in a concern of this kind is of vital importance. Everything possible has been and will be done to ensure that our machinery will be up-to-date, and we are advised that when it is complete it will compare favorably with, if it does not excel, any plant of its kind in the world.

"Not the least remunerative business in which we are engaged is the manufacture of cellulose lacquers. These lac-

quers are growing in public favor, with the result that sales are increasing. Another branch of the business deals with cellulose brushing paints, in which we have made good progress. Arrangements are now well in advance for marketing these goods on a considerable scale."

Mr. Greenhill further announced that Sir John Pennefather, Bart., M. P., and Dr. Herbert Levinstein, directors of the Non-Inflammable Film Co., Ltd., had joined the board. After his speech he invited those present to inspect a display of specimens of the company's products exhibited in the hall.

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## Improvements in Safety-Glass

(*Continued from page 99*)

### Bullet-Proof Glass

Another development of safety glass is the manufacture of bullet-proof glass for use in cashier's cages, armored cars and other places where protection from pistol fire is required. This glass is produced by essentially the same process as ordinary quarter-inch safety glass, but with this difference: Instead of two layers of glass and one of Pyroxylin, bullet-proof glass is made of three layers of glass and two of Pyroxylin. It is approximately one to one and one-half inches in thickness.

### Duplate

The Du Pont Viscoloid Company in conjunction with the Pittsburgh Plate Glass Company has developed a special safety glass known as Duplate.

Considering that the automobile industry is the largest consumer of plate glass in America, and that the demand for non-shatterable glass is already well established and constantly increasing, there is every reason to believe that Duplate and other types of non-shatterable glass will in time become standard equipment for windshields and windows of almost all cars. One cannot doubt that this glass will contribute materially to the solution of the great problem of safety on the highways.


MOLDING

BAKELITE DUREZ
Twenty Years Experience
Moulders since 1908

Service for Every Need

NOVELTIES - MECHANICAL AND ELECTRICAL PARTS

Northern Industrial Chemical Co.
11 Elkins St. Established 1908 Boston, Mass.

Anything Molded of Bakelite

A few interesting small parts made by
THE RECTO MANUFACTURING CO.
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PLASTICS
For Every Need
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HARD RUBBER GOODS
Moulders since 1897
Our experience insures High Grade
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WE SOLICIT YOUR INQUIRY
Jos. Stokes RUBBER CO.
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MOULDERS OF PLASTICS & BUILDERS OF MOULDS
*Electrical switches, with molded bakelite handles.*
KUHN & JACOB
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When writing these advertisers please mention *Plastics*

## Du Pont Viscoloid Co. Elects New President

CHARLES K. DAVIS has been elected president and general manager of the Du Pont Viscoloid Company succeeding Francis B. Davis, Jr., resigned after being elected president of the United States Rubber Company. The new head of the Viscoloid Company began his business career as an analytical chemist with the Aluminum Company of America and served successively with the American Steel Foundries Company, the American Smelting and Refining Company, and the Braden Copper Company in South America. He came with the du Pont Company in March, 1915, as a supervisor at the Hopewell smokeless powder plant, becoming, during the life of that plant, its assistant superintendent and then its superintendent. When Hopewell was shut down after the war, he went to Arlington, first as assistant manager and then as director of manufacture. When the Viscoloid Company was organized, he was selected as manager of the Leominister Plant and then as the company's assistant general manager.

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## Color Variety or Color Harmony?

(*Continued from page 103*)

stove, or kitchen cabinet that is his product?

It is apparent that for many kitchens the different items in this harmonious whole will have little in common besides color; granting for the moment that colors are standardized. This kitchen is too small for a kitchen cabinet (or has one built-in, and colored to harmonize with the walls) and in such cases the kitchen cabinet part of the group would be pulling the other piece of the group along without hope of a return.

Etc., etc. It is at least doubtful that the group can pull each individual piece along faster than it can push itself.

It simply can't be taken for granted that giving the pieces of the group a true color in common will equalize them in buying, selling, or using.

The addition of color has been a bit confusing, but the sales problem of these different pieces, as a group (kitchen color harmony) or as individual pieces, is just the same as it was in the white, unfinished, golden oak or walnut.

It is possible that manufacturers of related kitchen pieces can get together in small groups to work out and offer kitchens of real color harmony with good effect; pooling their interests actively in advertising and selling; the group selling the whole, the whole selling individual pieces.

On the other hand, it is possible that manufacturers of related kitchen pieces can do very well doing as they please with their colors; selling color as color, and giving such help toward harmony as may be required and desirable.

It is beyond all argument that ninety-nine out of 100 people are going to be more interested in color harmony involving the purchase of one individual piece and their own good sense than in color harmony that requires them to swallow a whole kitchen set-up.

You have to decide whether you're selling or going to sell, or want to sell, harmonious kitchens or colorful kitchens. Then you'll know what to do.

In any event, you'll be better off if the possibilities for bad color are limited by agreeing with others on what are proper color shades and setting these up as a universal standard.

Then the manufacturer who wants to sell color harmony can do it, and the housewife who wants color harmony can have it. And the others who just want to buy or sell or use color

(*Continued on page 114*)


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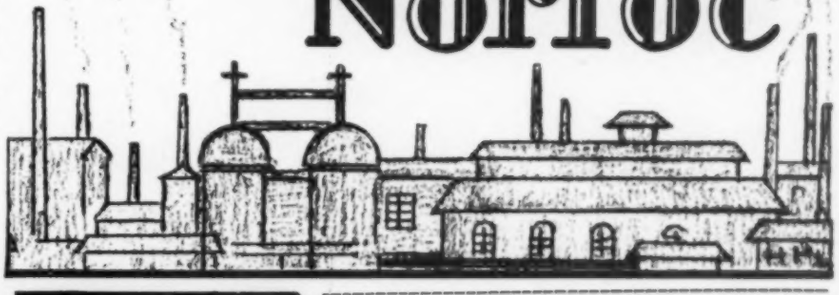

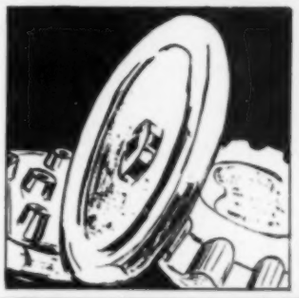

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Say you saw it in PLASTICS

## Domestic Exports of Pyroxylin Products, From the United States, by Countries

### November, 1928

| | | | | |
|---|---|---|---|---|
| Denmark | 181 | 50 | 14 | 93 |
| France | ..... | ..... | 3,597 | 785 |
| Germany | 615 | 759 | 2,117 | 656 |
| Hungary | ..... | ..... | 100 | 300 |
| Italy | 320 | 298 | ..... | ..... |
| Netherlands | ..... | ..... | 35 | 247 |
| Spain | ..... | ..... | 410 | 300 |
| Switzerland | ..... | ..... | 14 | 155 |
| United Kingdom | 56,431 | 48,756 | 9,501 | 4,349 |
| Canada | 143,402 | 105,533 | 71,976 | 65,508 |
| Costa Rica | 21 | 22 | ..... | ..... |
| Guatemala | ..... | ..... | 126 | 428 |
| Honduras | ..... | ..... | 3 | 21 |
| Nicaragua | ..... | ..... | 14 | 100 |
| Panama | 158 | 144 | 911 | 944 |
| Salvador | ..... | ..... | 61 | 252 |
| Mexico | 635 | 573 | 5,670 | 10,590 |
| Newfoundland & Lab. | ..... | ..... | 111 | 197 |
| Bermudas | ..... | ..... | 121 | 338 |
| Cuba | 500 | 425 | 1,589 | 2,462 |
| Dom. Republic | 60 | 75 | 116 | 372 |
| Netherland W. Indies | ..... | ..... | 260 | 349 |
| Argentina | ..... | ..... | 1,434 | 1,336 |
| Brazil | 75 | 68 | ..... | ..... |
| Chile | ..... | ..... | 10 | 25 |
| Colombia | 128 | 139 | 68 | 109 |
| Ecuador | 120 | 121 | ..... | ..... |
| Uruguay | ..... | ..... | 17 | 175 |
| Venezuela | 571 | 603 | 258 | 1,078 |
| B. Malaya | ..... | ..... | 11 | 34 |
| China | 78 | 85 | 475 | 728 |
| Java & Madura | 23 | 12 | ..... | ..... |
| Philippine Islands | 355 | 485 | 3,429 | 3,391 |
| Australia | 8,313 | 6,261 | 4,250 | 4,731 |
| New Zealand | ..... | ..... | 287 | 646 |
| B. E. Africa | 16 | 14 | ..... | ..... |
| Union of South Africa | ..... | ..... | 514 | 902 |
| Total | 212,002 | 164,423 | 107,499 | 101,601 |
| Shipments from U. S. to: | | | | |
| Hawaii | 76 | 152 | 832 | 871 |
| Porto Rico | 20 | 28 | 806 | 1,192 |

## Color Variety or Color Harmony?

(*Continued from page 113*)

can do it, too, without sacrificing the chance of building harmony up step by step, piece by piece.

To my mind, harmonious kitchens and colorful kitchens are two widely different problems. One, briefly, is a contract, a specialized proposition, in which the architect, the decorator, the painter would be more relied upon than the advertising page or the local dealer. The other is simply the matter of settling upon the best colors, that people do and will like best and most generally, and using them.

### It Should Be Color in the Kichen Rather Than Colors

Color in the kitchen is a good thing but it should be color rather than colors. With manu-

### Shellac Industry Threatened By Advance of Cellulose

A statement recently issued by the Bengal Department of Industries regarding the shellac trade draws attention to the antiquated and wasteful methods in vogue and recalls the disappearance of the Indian indigo industry owing to analogous defects. The department expresses the view that the same kind of threat lies at the door of the lac industry.

"True," says the Director of Industries, "a complete substitute for shellac has so far not been produced, but as a varnish it is being displaced rapidly in many directions by the cellulose products of the modern chemist. The existing industry can only retain its present strong position by improving the quality and cheapening the cost of its product and the preparation for export under standardized conditions."

The chief difficulty hindering reform, and one which the department believes can be offset by patient and prolonged propoganda, is that the common lac producer in Bengal is the ordinary ill-educated and conservative villager who has a few lac-bearing trees, usually the "Kool" tree, round his homestead land. He seldom takes to the cultivation of lac as seriously as he takes to the production of a staple crop like paddy or an economic crop like jute. The lac crop is often left to take care of itself, and it is only in years of very high prices that the cultivator pays any attention to it, and then only to the extent of guarding the mature crop from theft.

"There are, however, the big jotedars and other comparatively well-off people, who have large numbers of lac-bearing trees growing on their lands. The raising of lac from such trees is sometimes done by the landholders themselves, and at other times it is entrusted to the agents of big lac dealers on what is known as the 'adhi' system, in which the dealer's man is allowed a share of the crop, usually one-half of it, in return for his doing everything necessary for the raising of the crop and bearing all expenses relatingthereto. There are very few instances in Bengal of regular plantations of lac-bearing trees and of cultivation of lac on modern scientific lines. However, it is gratifying to note that as a result of the cooperation of the Government departments concerned with the enterprising lac growers, people generally are gradually coming to known of the value of lac cultivation on improved methods."

It is further pointed out that the refined lac now produced is replacing the Indian shellac on the American and European markets. Even stick lac, with a guaranteed percentage of sticks, is being bought in the Indian market by foreign buyers. The "kiri" and other residues in the melting of lac are also bought by overseas buyers, and the lac is recovered from these profitably.

---

facturers vigorously competing for business it may seem rather a hopeless task to harmonize the widely divergent views. But it can be done. In any event it is high time to be writing letters back and forth swapping ideas, having discussions and agreeing, in small groups or large, upon colors or definite true shades. The trouble is that up to now each manufacturer concerned has been working by himself. This is more or less to be expected but in the genesis of any new idea, common sense nearly always comes to the rescue and brings order out of chaos. Seemingly little thought has been devoted to it thus far.

The whole thing has been carried out on the basis of impulse rather than thinking. If a little practical merchandising is not introduced into this problem pretty soon certain industries are likely to have a fever of the kind that kills off the patient before he knows he is sick.

### Domestic Exports of Pyroxylin Products, From the United States, by Countries

#### October, 1928

| | | | | |
|---|---|---|---|---|
| Denmark | ..... | ..... | 28 | 154 |
| Germany | 176 | 192 | ..... | ..... |
| Italy | 100 | 150 | ..... | ..... |
| Norway | ..... | ..... | 60 | 306 |
| Spain | ..... | ..... | 145 | 329 |
| Sweden | ..... | ..... | 2 | 11 |
| Switzerland | ..... | ..... | 13 | 85 |
| United Kingdom | 157,013 | 94,068 | 14,664 | 14,513 |
| Canada | 211,151 | 128,775 | 29,514 | 56,321 |
| Guatemala | 20 | 24 | 147 | 544 |
| Honduras | 4 | 6 | 13 | 38 |
| Nicaragua | ..... | ..... | 7 | 59 |
| Panama | ..... | ..... | 16 | 58 |
| Salvador | 28 | 30 | 37 | 173 |
| Mexico | 267 | 178 | 3,016 | 4,675 |
| Newfoundland & Lab. | ..... | ..... | 134 | 207 |
| Cuba | 1,211 | 1,087 | 1,300 | 2,443 |
| Dom. Republic | ..... | ..... | 15 | 27 |
| Argentina | ..... | ..... | 426 | 1,766 |
| Chile | 353 | 258 | 73 | 624 |
| Colombia | ..... | ..... | 484 | 1,015 |
| Ecuador | 16 | 23 | ..... | ..... |
| Peru | ..... | ..... | 174 | 386 |
| Venezuela | 323 | 370 | 20 | 58 |
| Ceylon | 36 | 40 | ..... | ..... |
| China | 206 | 216 | 15 | 30 |
| Persia | 231 | 243 | ..... | ..... |
| Philippine Is. | 152 | 350 | 1,484 | 3,205 |
| Australia | 205 | 191 | 4,545 | 5,143 |
| B. Oceania | ..... | ..... | 6 | 13 |
| B. E. Africa | ..... | ..... | 49 | 224 |
| Union of South Afr. | ..... | ..... | 515 | 1,034 |
| Total | 371,492 | 226,201 | 56,902 | 93,441 |
| Shipments from U. S. to: | | | | |
| Hawaii | 23 | 47 | 3,015 | 3,067 |
| Porto Rico | ..... | ..... | 492 | 633 |

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